PUBLICATION 360

1984
Fruit Production Recommendations

Ministry of
Agriculture
and Food
ONTARIO
Dennis Timbrell
Minister

Agdex 206/11

POLICY STATEMENT

In this publication, most recommendations list several pesticides that are effective for each insect or disease discussed. Where possible, the less hazardous materials and those that growers have used satisfactorily for a number of years are listed first. These are followed by the more toxic pesticides and/or newer ones with which we have less experience. It must be emphasized that, in some cases, the most effective pesticides are highly toxic.

Weather and other factors influence the effectiveness of pesticides and the likelihood of plant injury by control chemicals. Consult the package label and other information regarding compatibility with other materials, the effect of high or low temperatures, poor drying conditions, etc. Wettable or soluble powder (WP or SP) preparations generally are less likely to cause plant injury than liquid concentrate (EC, SC, and F) formulations.

A number of brand names of pesticides are given in the calendars as a convenience to the fruit grower and are neither an endorsement of the product nor a suggestion that similar products are not effective.

Pesticide products listed in this publication have been reviewed by the Ontario Pesticides Advisory Committee and have been classified under the Pesticides Act.

The pesticide recommendations are revised annually by the Ontario Crop Protection Committee, which is composed of personnel of the Ontario Ministry of Agriculture and Food and of Agriculture Canada. **Old editions should be discarded.** Commercial fruit growers should consult Spray Service Circulars issued by the Horticultural Crop Advisors, Ontario Ministry of Agriculture and Food, for changes that may be recommended when additional information is available, or because of local outbreaks or unusual weather conditions. An agri-phone system is in operation during the growing season throughout most of the areas involved in horticultural production. Three-minute recorded messages, updated daily, provide timely information on pest development (see page 2).

Under certain conditions, fungicides and insecticides may cause plant injury. Read the cautions on the label and consult the manufacturer's information about compatibility before combining products in a spray mixture. See Table 4. The pesticide recommendations are for commercial plantings. Home gardeners should use products recommended for home gardens.

ACKNOWLEDGMENTS

The recommendations contained in this publication have been prepared in consultation with:

- Ontario Crop Protection Committee
- Ontario Fruit Research Committee
- Ontario Weed Committee
- Ontario Soil Management Research Committee

and personnel of:

- Plant Industry Branch, Ontario Ministry of Agriculture and Food
- Agriculture Canada
- Ontario Agricultural College, University of Guelph
- Horticultural Research Institute of Ontario
- Kemptville College of Agricultural Technology
- Ontario Ministry of the Environment
- Ontario Ministry of Labour
- Health and Welfare Canada

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HORTICULTURAL CROP ADVISORS
ONTARIO MINISTRY OF AGRICULTURE AND FOOD

Counties or Area Served	Name	Address	Phone No.
Eastern Ontario	Steve Rowe	College of Agricultural Technology Kemptville, K0G 1J0	613-258-3411
Prince Edward, Hastings	Jody Bodnar	P.O. Box 470, Picton, K0K 2T0	613-476-3224
Northumberland, Peterborough,	Dave Ridgway	P.O. Box 340, Trenton, K8V 5R5	613-392-3527
Durham, Victoria	Bev Ells	234 King Street East Bowmanville, L1C 1P5	416-623-3348
North York (Bradford Marsh Area)	Matt Valk*	Muck Research Station R.R. 1, Kettleby, L0G 1J0	416-775-3783
Simcoe, Dufferin, Grey	Ken Wilson	P.O. Box 69, Clarksburg, N0H 1J0	519-599-2042
Halton, Peel, North Wentworth	Joe Uyenaka	17 Wilson Drive, Milton, L9T 3J7	416-878-2314
Niagara Peninsula	Ian Smith, Wayne Roberts	Vineland Station, L0R 2E0	416-562-4142
Norfolk, Brant	Russ Chard	P.O. Box 587, Simcoe, N3Y 4N5	519-426-7120
Oxford, Elgin	Keith Priest	P.O. Box 666, Woodstock, N4S 7Z5	519-537-6621
Lambton, Middlesex, Huron	John Gardner	367 Ridout St. N., London, N6A 2P2	519-434-6811
Essex, Kent	Ed Tomecek	College of Agricultural Technology Ridgetown, N0P 2C0	519-674-5456
Essex, Kent	Clem Fisher Leslie Huffman	Research Station, Harrow, N0R 1G0	519-738-2251
Horticultural Crop Advisor (Potatoes)	Sam Squire	P.O. Box 370, Alliston, L0M 1A0	705-435-5521
Horticultural Crop Advisor (Flowers)	John Hughes	Dept. of Horticultural Science University of Guelph, N1G 2W1	519-824-4120
Horticultural Crop Advisor (Flowers & Mushrooms)	Wayne Brown	Vineland Station, L0R 2E0	416-562-4142
Horticultural Crop Advisor (Nursery)	Burke McNeill	17 Wilson Drive, Milton, L9T 3J7	416-878-2314
Horticultural Crop Advisor (Marketing)	Bob Cobbledick	Vineland Station, L0R 2E0	416-562-4142
Extension Pathologist	Craig Hunter	P.O. Box 587, Simcoe, N3Y 4N5	519-426-7120

* *Horticultural Research Institute of Ontario staff.*

If a problem arises in connection with special pests, spray mixtures or spraying, and other cultural practices, telephone or write the Horticultural Crop Advisor serving your area.

Agri-phones

Georgian Bay	519-599-2915	Milton	416-876-1383	Woodstock	519-537-7161
Kingsville	519-733-3151	Newmarket	416-775-3493	St. Catherines	416-684-6684
Chatham	519-352-0222	Smithfield	613-392-3422	London	519-438-1014
Simcoe	519-426-7810	Vineland	416-562-4345	Bowmanville	416-623-4944

ONTARIO MINISTRY OF THE ENVIRONMENT – PESTICIDES CONTROL FIELD OFFICES

Counties	Field Officers	Telephone
Central Region		
Halton, Peel, York, Durham, Toronto	T. O'Neill & D. Trenholm 150 Ferrand Drive, Suite 700, Don Mills M3C 3C3	416-424-3000 (ext. 204)
Peterborough, Victoria, Haliburton, Northumberland	A.G. Carpentier 139 George Street N., Peterborough K9J 3G6	705-743-2972
Simcoe, Muskoka	W. Cowie 12 Fairview Road, Barrie L4N 4P3	705-726-1730
West Central Region		
Haldimand, Norfolk, Niagara, Hamilton-Wentworth	J. Percy Ont. Gov't. Bldg., 119 King St. W. Hamilton L8N 3Z9	416-521-7640
Dufferin, Wellington, Waterloo, Brant	R. Miller Ont. Gov't. Bldg., 119 King St. W. Hamilton L8N 3Z9	416-521-7640
Southwestern Region		
Elgin, Middlesex, Oxford	D.C. Morrow & W. Lampman 985 Adelaide Street South, London N6E 1V3	519-681-3600
Essex, Kent, Lambton	H.E. Collins P.O. Box 237, 435 Grand Ave. W. Chatham N7M 5K3	519-352-5107
Bruce, Grey, Huron, Perth	B.T. Lobb 20 King Street, P.O. Box 688 Ont. Ministry of Agr. & Food Bldg. Clinton N0M 1L0	519-482-3248
Southeastern Region		
Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville	D.A. Raddon 133 Dalton St., Box 890, Kingston K7Z 4X6	613-549-4000
Prescott & Russell, Renfrew, Stormont, Dundas & Glengarry, Ottawa-Carleton, Lanark	R.P. Cameron 2378 Holly Lane, Suite 204, Ottawa K1V 7P1	613-521-3450
Northeastern Region		
Manitoulin, Nipissing, Parry Sound, Sudbury	D.J. Mewett Northgate Shopping Centre, 1500 Fisher St., North Bay P1B 2H3	705-476-1001
Cochrane, Timiskaming, Algoma	P. McCubbin 83 Algonquin Blvd. W., Timmins P4N 2R4 Sault Ste. Marie	705-264-9474 705-949-4640
Northwestern Region		
Kenora, Rainy River, Thunder Bay	G.R. Gammond Ontario Government Building, 435 James St. S. Thunder Bay "F" P7E 6E3	807-475-1305
Head Office	Commercial & Agricultural Chemicals Section 135 St. Clair Avenue W., Suite 100 Toronto, Ontario M4V 1M2	416-965-2401

PUBLICATIONS – The following publications are available from any of the Pesticide Control Field offices or from Commercial & Agricultural Chemicals Section, Suite 100, Ministry of the Environment, 135 St. Clair Ave. W., Toronto, Ontario M4V 1P5:

- Personal Protective Equipment for Pesticide Users
- Chemical Safety Handbook
- Pesticides Act and Regulations
- Chemical-Storage Signs

PRECAUTIONS WITH PESTICIDES

1. Always read the label before opening pesticide containers, and follow all precautions and directions.
2. Never smoke, chew tobacco or eat while handling or applying pesticides. DO NOT carry such items in clothes used for spraying.
3. Always wear neoprene gloves to handle the concentrate. Wear a mask to reduce pesticide inhalation especially when handling dusty formulations or volatile concentrates. Avoid inhaling spray droplets, dust or fumes by wearing a respirator.
4. Avoid spilling pesticides on skin or clothing.
5. Wear freshly laundered clothes each day.
6. Avoid contamination of water supplies, wells, ponds, streams, etc. with pesticides when filling or flushing spray equipment. Never fill a sprayer directly from a stream or pond unless the unit is equipped with an anti-backflow device to prevent siphoning.

IF ACCIDENTS OCCUR

1. If an accident occurs, remove contaminated clothing immediately, and wash contaminated skin thoroughly with soap and water. Wash clothing before reuse.
2. If clothing becomes wet with a pesticide, when spraying, remove it immediately. When the spray operation is complete, remove contaminated clothes, have a bath or shower and put on freshly laundered clothing.
3. Clean up any pesticide spills immediately. Use dry soil or other absorbent material to remove excess liquid. If the spill is major, contact the nearest office of the Pesticide Control Service for advice. (See list page 3.)
4. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to a hospital immediately. If possible, take a labeled container of the pesticide with you. (See Emergency Procedures for Pesticide Poisoning, page 6.)
5. If a well becomes contaminated follow clean up instructions given in Ontario Ministry of Agriculture and Food Factsheet, *Pesticide Contamination of Farm Water Supplies*, Agdex 607.

SPECIAL INSTRUCTIONS

It should be emphasized that all pesticides are toxic and must be handled safely. In addition, there are major deficiencies in the toxicological information of a number of pesticides (insecticides, fungicides and herbicides) because of the many tests that were conducted by the Industrial Biotest Laboratory (IBT) that were invalid. Replacement studies are currently being conducted by the respective registrants. Those handling and applying these chemicals must pay special attention to the precautions outlined above.

At the time of printing this publication, pesticides included in the 1984 Fruit Production recommendations requiring additional studies are as follows:

CSA COMMON NAME	TRADE NAME
captafol	Difolatan
endosulfan	Thiodan
folpet	Phaltan
formetanate hydro chloride	Carzol
methidathion	Supracide
oxydemeton-methyl	Metasystox-R
paraquat	Gramoxone

Storage

1. **General Storage:**

   The Ontario Pesticides Act and Regulation 751 require that all pesticides be kept out of the reach of children, irresponsible persons, pets and livestock. They should be stored in a locked facility away from food for humans, and feed for animals. Herbicides should be stored separately from other pesticides to avoid possible contamination.

   Special Storage:

   Schedule 1, 2 and 5 pesticides must be stored in a storage facility which is ventilated to the outside atmosphere. A placard bearing the words **"Chemical Storage Warning – Authorized Persons Only"** in block capitals must be affixed to the outside of each entrance. Entry to the storage facility should only be made by the person responsible for the pesticide, or with his permission.
2. **Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers.** See also OMAF Factsheet, *Farm Storage of Pesticides*, Agdex 607.
3. Post pesticide storage areas with proper notices.
4. In areas where flooding has been a frequent occurrence, fertilizers and pesticides must be stored above the known high water mark to avoid contamination of the flood waters. Contamination of water by these chemicals can and has led to serious health problems, affecting humans, domestic animals as well as fish and wildlife.

Disposal of Pesticide Containers and Contaminated Material

1. Containers from pesticide packages, and any paper or other material used to clean up spills, should be buried or burned. Make sure that people and animals are kept away from the smoke, and that the smoke is not directed toward buildings, highways, roads, or outdoor public areas.
2. Un-rinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the drum it could be dangerous to other people handling it, or to the environment (for example, your water supply). Failure to rinse is also wasteful – why not use that 3% for the purpose for which it was purchased, i.e., to control the pest!

   Rinse all empty metal or glass containers three times with water and add washings to the spray tank. Or, use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic drum, and to rinse the residual left in the container directly into the spray tank. This procedure takes less than a minute and results in a rinsed container. The rinsed containers may be crushed, buried and covered by at least 50 cm of soil, away from any watercourse or water table.

Protective Clothing when using Pesticides Outdoors

1. When measuring and mixing pesticides, wear neoprene or rubber gloves, rubber boots, a protective apron or coveralls, and protective eyeshields.
2. Disposable gloves, aprons, overalls and hat covers are available at reasonable prices from the major safety supply companies.
3. Wash all clothing after use.
4. Wear a chemical respirator with dual cartridges when mixing and applying pesticides. Consult the following chart for proper selection. Never interchange components.

TABLE 1. DUAL CHEMICAL CARTRIDGE RESPIRATORS RECOMMENDED FOR OUTDOOR PROTECTION FROM PESTICIDES (LISTED IN NUMERICAL ORDER ACCORDING TO NIOSH APPROVAL NUMBERS)

NIOSH Approval Number	Approval Issued To	Respirator No. and Description	Component Numbers	Available From
TC-23C-54	Willson	112115 (2 sizes) Half-face	R21 Cartridges R15 filters	Safety Supply Canada Toronto
TC-23C-74	Norton	7549L 7549M 7549S (3 sizes) Half-face	N7500-21 Cartridges N7500-23 Filters N750-27 Filter Cover	Siebe-Norton, Inc. Toronto
TC-23C-78	3M	Powered Air Purifier (pesticide) White Cap Helmet Full-face	Cartridges Filters and Hood and Vest Kit	Safety Supply Canada Toronto
TC-23C-106	American Optical	R4058 R5058 R6058 Half-face (3 sizes)	R58A Filter/ Cartridges	AO Safety Products Div. of AOCO, Toronto
TC-23C-117	Scott	Scott Respirator 64-OVP Half-face (3 sizes)	642-OV Cartridges 642-F Filters	Safety Supply Canada Toronto
TC-23C-123	3M	8751 Half-face	Pre-filter 8752 Retainer 8733	Safety Supply Canada Toronto
TC-23C-124	Safety House	236-G100 F104 Half-face	G100 Cartridges F104 Filters	Safety House of Canada, Toronto
TC-23C-133	Willson	162115 172115 Full-face	R15 Filters R21 OV Cartridges	Safety Supply Canada Toronto
TC-23C-148	MSA	460560 (3 sizes) Full-face	464025 Combination Cartridges	MSA of Canada, Downsview
TC-23C-178	Norton	75BP 49L 75BP 49M (2 sizes) Full-face	N-7500-21 Cartridges N-7500-23 Filters Back-pack	Siebe-Norton, Inc. Toronto
TC-23C-190	Norton	7649L 7649M 7649S Silicone Full-face (3 sizes)	N-7500-21 Cartridges N-7500-23 Filters	Siebe-Norton Inc. Toronto
TC-23C-202	H.S. Cover (York)	MY 1482 G	100 Cartridges 104 Filters	Levitt-Safety Ltd., Toronto
TC-23C-224	Scott	Scott Respirator 65-OVP Full-face (2 sizes)	642-OV Cartridges 642-F Filters	Safety Supply Canada Toronto

Table 1 (continued)

NIOSH Approval Number	Approval Issued To	Respirator No. and Description	Component Numbers	Available From
TC-23C-238	American Optical	R7058 Full-face	R58A Filter/ Cartridges	AO Safety Products Div. of AOCO Toronto
TC-23C-281	American Optical	R4563 R5563 R6563 (3 sizes)	R563A Filter/ Cartridges	AO Safety Products Div. of AOCO Toronto
TC-23C-282	American Optical	R7563 Full-face	R563A Filter Cartridges	AO Safety Products Div., of AOCO Toronto
TC-23C-323	Survivair	2131-00 2231-00 2331-00 (3 sizes)	1001-00 Cartridges 1030-00 Filters	Levitt-Safety Ltd., Toronto
TC-23C-374	Willson	3021155 Breathing Assist Respirator	R15 Filters R21 OV Cartridges	Safety Supply Canada Toronto
TC-23C-375	Willson	322115 Breathing Assist Respirator	R15 Filters R21 OV Cartridges	Safety Supply Canada Toronto

Additional information on protective equipment may be found in Personal Protective Equipment for Pesticide Users, available at offices of the Pesticide Control Service, your pesticide dealer, and offices of the Ontario Ministry of Agriculture and Food.

EMERGENCY PROCEDURES FOR PESTICIDE POISONING

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water.

If a pesticide has come in contact with the eyes, rinse them with plenty of water for 15 minutes.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL, TAKING THE LABELED PESTICIDE CONTAINER WITH YOU.

FIRST-AID INFORMATION

The Occupational Health and Safety Division, Ministry of Labour, 400 University Avenue, Toronto, M7A 1T7, has physicians available for consultation on first-aid information and advice. They can be contacted:

Between 8:00 a.m. and 5:00 p.m. Monday to Friday. Telephone (416) 965-3610.

During weekends, public holidays and non-office hours. Telephone (416) 965-1211 and ask for the "on-call" physician.

All pesticide products are registered by Agriculture Canada. No pesticide may be used on any crop for which it is not registered. Such use can result in seizure of the crop.

REENTRY TO TREATED AREAS

Pesticide poisoning may occur where workers enter fields too soon after pesticides have been applied. Such poisoning can result from handling treated plants or from inhalation of pesticide vapors.

The pesticides listed below are those for which a specific minimum interval must be observed from the time of application to the time of working in the crop. For some pesticides, e.g. parathion, the label carries a warning regarding working in treated crops. **Follow these recommendations.** Where no label warnings are provided, the following minimum intervals are recommended. Minimum reentry time of 24 hours is indicated thus[1]. Minimum reentry time of 48 hours is indicated thus[2]. Minimum reentry time of 7 days is indicated thus[3].

24 Hours	48 Hours	7 Days
[1]Lannate	[2]APM 50	[3]Parathion
[1]Phosdrin	[2]Guthion	
[1]Supracide	[3]Systox	
[1]Vydate	[2]Furadan	

BLOOD TESTS FOR THOSE APPLYING PESTICIDES

Organophosphorus and carbamate pesticides are capable of inactivating the serum and the red blood cholinesterase levels. If the activity of cholinesterase falls below a critical level, human poisoning can result as exhibited by fatigue, dizziness, nausea, trembling, blurred vision, difficulty in breathing and other symptoms.

For those working outdoors and applying these groups of pesticides, it is strongly recommended that cholinesterase levels be checked by your family doctor. To be of value the tests should be commenced prior to using these pesticides and not after applications have commenced, since the normal level per individual can vary considerably, making it difficult to assess the degree of suppression. In this publication the primary insecticides of concern are – Guthion, Lannate, Parathion, Systox, Furadan, Phosdrin, Supracide, APM 50, Basudin, Cygon, Imidan, Pirimor, Vydate, and Zolone.

PESTICIDE DRIFT

Pesticide drift can leave unwanted residues on adjacent crops, be a hazard to people and livestock nearby, or reduce the amount of material in the target area so that it is ineffective. Those applying pesticides should make every effort to minimize or prevent pesticide spray drift by paying attention to:

1. correct calibration and maintenance of spray equipment
2. correct operation of the equipment
3. being aware of the toxicity of the pesticide in use
4. being aware of the weather conditions

For more information consult OMAF Factsheet, *Pesticide Drift*, Agdex 607 or Canadex 607, *Pesticides: Effects of Drift and Droplet Size*.

AIRCRAFT APPLICATION

Aerial applicators must be licensed by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the authority of The Pesticides Act 1973 for the application of Schedule 1 and 5 pesticides, and Schedule 2 hormone-type herbicides. The area will be inspected by Ministry personnel to ensure safety of application.

It is an offense under the Federal Pest Control Product Act to use a control product under unsafe conditions. Precautionary practices must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honeybees, e.g. Sevin (carbaryl).

Applications should not be made if the wind is blowing. Some drift occurs even on the stillest day. To keep drift to a minimum, apply pesticides in the evening or early morning.

Be sure that the product to be used and its rate of application are specified in the contract.

RELATIVE TOXICITY TO HUMANS OF PESTICIDES RECOMMENDED ON FRUIT CROPS

Wear a chemical cartridge respirator with a dual chemical cartridge suitable for the pesticide to be used, (see page 5), for protection against most pesticides. It is recommended for outside use against light concentrations of pesticides. This type of respirator and cartridge should be used along with rubber or neoprene gloves, rubber boots and protective eye shields when handling or mixing any of the pesticides listed below. It is also worn when applying extremely toxic or highly toxic compounds outdoors.

Extremely Toxic

Guthion
Lannate
Parathion
Systox
Furadan
Vydate
Phosdrin
Gramoxone (paraquat)
Supracide
Zinc phosphide
APM 50

These pesticides are dangerous through inhalation, skin contact or if taken by mouth. A few grams can be fatal. Always wear protective clothing when mixing or applying these chemicals (page 4). Avoid mixing in windy areas and dispose of containers properly (page 4). Always change clothing and wash up immediately after using these materials.

Moderately Toxic

Basudin (diazinon)
Captan*
Cygon 480E
Decis
Ethion
Elgetol (DNOC)
Imidan
Plictran
Pirimor
Thiodan
Vorlex
Zolone

These pesticides are dangerous if handled carelessly. Caution is required to insure that they are not taken internally or allowed to contact the skin. Wear protective clothing, including respirator and goggles, when mixing or working with them in confined areas. Avoid breathing the vapors. Triple rinse and dispose of containers properly (page 4). Always change clothing and wash up immediately after using these materials.

* *Current studies indicate that Captan requires special handling procedures as outlined on the label. Read and follow directions closely.*

Pesticides listed in this calendar and not appearing on this list are less toxic, but should be handled with all precautions listed on the label. Even the most toxic pesticide can be used safely, if used properly, by following all directions and precautions listed on the label.

The pesticides listed in this publication are registered by Agriculture Canada, Ottawa. A pesticide should not be used on any crop unless it has been registered for that crop.

PESTICIDE INJURY TO CROPS

Although insecticides and fungicides have been selected and formulated to avoid plant injury, damage can still occur under some conditions. In addition to the cautions mentioned in this publication, there are a number of other cautions which should be observed:

1. Apply sprays when the drying condition is fast. Some chemicals break down to components which are injurious to plant tissues if they are permitted to stay wet.
2. Apply sprays when the temperature is below 27°C. The spray deposits serve as a lens and concentrate the heat on the plant tissues.
3. Be particularly careful when plants have been under growth stress such as prolonged periods of drought, excessive cloud cover, extremely low or high temperatures.
4. Apply sprays soon after mixing. Undesired chemical change may take place with some chemicals if the sprays remain in the tank for prolonged lengths of time, e.g. overnight. In other cases, the chemicals may settle out and clog the lines.

PESTICIDE RESISTANCE

Many of the pesticides recommended have a very specific mechanism of action. That is, they act on a single system or site in the organism. These materials should not be used continuously and repeatedly in a season-long program since this will increase the chance of the development of pest resistance.

In our recommendations we suggest that such compounds be used in combination or that they be alternated so that the likelihood of resistance development is reduced.

Note that several pesticides may act similarly. Benlate and Easout act on the same site. If resistance develops to one, it is likely to apply to the other. This is called cross-resistance.

Thus, alternating these compounds with each other will not be useful. Rather, they should be alternated with fungicides with different modes of action as, for example, captan or maneb.

The synthetic pyrethroids represent a new group of chemical insecticides. All of these materials are considered broad spectrum insecticides capable of killing a wide variety of insects. This means that target pest species as well as beneficial species are killed. In many of our crop situations we are relying upon beneficial insects and mites to keep pest populations under control. In many cases the beneficial species are just as important as chemicals in controlling pest species.

With some of the pest problems such as Tentiform Leafminer and Pear Psylla, the conventional pesticides are not providing acceptable control of target pests. As a result, the synthetic pyrethroids have become important chemicals in pest control.

We do not promote repeated use of the pyrethroid compounds because it may lead to tolerance or resistance problems. Also, if beneficial species are killed off, more reliance must be placed on pesticides to control pest species. Pyrethroid usage is likely to be the least harmful to beneficial species when applied during the prebloom period.

Growers can prolong the effective life of the pyrethroid insecticides through cautious use of these materials:

1. These materials should only be used when other materials are not giving adequate control.
2. Continued use season-long is not advised.
3. Try to restrict use to prebloom or an emergency situation only.

The synthetic pyrethroids recommended in publication 360 include:

Ambush (permethrin)
Belmark (fenvalerate)
Decis (deltamethrin)

INTEGRATED PEST MANAGEMENT

Much has been said in recent years about integrated pest management and reduced use of pesticides. In Ontario, integrated pest management has been a part of the pest control program. While it is not possible at this time to include a complete integrated pest management program in the recommendations, significant progress has been made and growers are urged to take advantage of the additional information.

THE CONCEPT

In the late 1960s, it became apparent that total reliance on chemical pesticides for pest control was not a good practice. A decision was made to move as quickly as possible to more efficient use of pesticides in Ontario agriculture. The concept of integrated pest control was adopted. This involves all possible methods of pest control, including various horticultural practices, to maintain pests at low levels such that they do not cause economic damage.

In Ontario, the first major program on integrated pest management was developed with the peach crop. Success in that area has permitted expansion into other crops. Presently, much of the progress in pest management has been due to effective methods of monitoring for pests so that treatments are applied only when needed. Pest management programs are now available on apples, grapes and peaches in the areas of the province with concentrations of these crops.

The programs have provided good control at reduced costs because of a reduced number of spray treatments and reduced dosages of pesticides.

WHAT IS INVOLVED

The keys to a successful integrated pest management are: selecting tolerant varieties for new plantings; practicing good sanitation by removing wild hosts that may carry pests; and using sound cultural practices and applying treatments with a properly functioning sprayer. The use of sex pheromones and other attractants by which specific insects can be drawn into traps has been a major development in improving our ability to determine when pests are present and at what levels sprays must be applied.

In addition, pest management includes proper selection of pesticides and dosage rate so that minimum damage is done to beneficial parasites and predators. Spray applications are then timed to critical stages in the development of the pest. There is, thus, an intensive involvement of the Horticultural Crop Advisor, pest management specialist, and the grower working as a team to arrive at the best control practice. This is not a program on which farmers can embark on their own. Rather, they should be in regular contact with the Horticultural Crop Advisor or pest management specialist to develop and carry out their program.

How To Get Information

The extension service of the Ontario Ministry of Agriculture and Food has developed a network of Agri-phones (page 2) that will provide for specific areas data on weather, including a five-day forecast, horticultural advice, the status of insect and disease pests, and general information of value to the grower in planning the crop production program. Agri-phones are not available in all areas and it is important that the grower check with the Horticultural Crop Advisor (page 2) to determine if the information needed for a pest management program is available in the area, and how to get involved in the program.

In order to make pest monitoring and advisory services more available to growers, local pest management specialists have been provided to work with Horticultural Crop Advisors in three regions of Ontario. The regional specialists are located in the offices of the Ontario Ministry of Agriculture and Food in London, Simcoe and Bowmanville.

POLLINATION

Pollination is essential for the production of most fruits. Many growers provide for this by arranging to have beekeepers move honeybee colonies into the crop during the blooming period. The following suggestions may help in utilizing the services of honeybees more efficiently for this purpose:

1. Obtain honeybees from a reliable beekeeper who is able to supply strong, healthy colonies. Weak colonies are of little value for early spring pollination when cool weather is often encountered.
2. Two colonies of honeybees per hectare should provide satisfactory pollination for most fruits. In young orchards fewer bees may be required. However, because of the unfavorable weather frequently encountered during the time when the earlier-blooming apricots, cherries and plums are in blossom, the grower may be well-advised to use more bees per hectare. For use with pollen inserts, five colonies per hectare are suggested.
3. Set out the colonies after the blossoms have partially opened (earlier for sweet cherries). This will encourage a greater number of bees to work on the fruit blossoms in the surrounding orchard rather than to forage elsewhere. This consideration is extremely important for the effective use of pollen inserts.

4. Since cool weather is often encountered during fruit bloom, encourage maximum honeybee flight by giving the colonies some protection from cold spring winds. Place the colonies in small groups in sunny, sheltered locations. Where no natural windbreak is available, it is wise to erect a temporary wind shelter. Bales of straw are quite satisfactory for this purpose. Try to place the colonies so that the morning sun will strike the hive entrances.

NOTE: Pollination cannot be expected to produce results in orchards that are suffering from nutritional deficiencies, insect or disease problems, poor drainage, or other adverse conditions. Do not expect greatly improved crops from the use of bees and pollen inserts until such deficiencies have been corrected.

A pollen insert is a device that can be inserted into the entrance to a honeybee colony in such a way that bees leaving the hive are forced to crawl through a shallow tray containing pollen from the desired pollenizer. Sufficient pollen will usually adhere to the legs and body of each foraging bee to enable it to cross-pollinate the blossoms it visits. For additional information on the use of pollen inserts, consult the Horticultural Crop Advisor serving your area, or the Department of Environmental Biology, University of Guelph.

REDUCE BEE POISONING

Bees are essential for the pollination of most tree and small fruits. Insecticides, many of which kill bees, are required for insect control. With careful management, you can obtain both pollination and insect control. You can protect the bees by following these suggestions:

1. **Do not apply insecticides while tree fruits are in bloom. The "Bees Act" makes it an offence to do so in Ontario.**
2. Remove honeybee colonies as soon as pollination is complete and before any postbloom insecticides are applied.
3. Time of treatment is important. In general, daytime treatments, when bees are foraging in the field, are most hazardous. Insecticide applications in the early morning or evening are safest.
4. If there is a risk of honeybee poisoning, try to choose an insecticide that is not highly toxic to the bees (use pesticide rating, page 9).
5. Honeybees frequently are poisoned by visiting cover crops, such as dandelions or clovers, that are in bloom in the orchard. Clipping such crops prior to spraying will help safeguard the bees.

Extremely Toxic to Bees — Sevin

This insecticide has caused more loss (confirmed cases of poisoning) to bees than any of the other materials listed below. Fruit growers and apiarists require close liaison where this material is applied.

The following groups (chemicals used with fruit crops) show the relative toxicity of pesticides to honeybees as determined by laboratory and field tests in California.

Group I — Pesticides Highly Toxic to Bees

Severe losses may be expected if the following materials are used when bees are present at treatment time or within a few days thereafter:

diazinon
Cygon
Imidan
Ambush
Decis
Guthion
malathion
parathion
Belmark
Sevin
Phosdrin
Furadan
APM 50

Group II — Pesticides Moderately Toxic to Bees

These can be used around bees if dosage, timing, and method of application are correct, but should not be applied directly on bees, in the field or at the colonies:

Lannate
Thiodan
Zolone
Pirimor

Group III — Pesticides Relatively Non-Toxic to Bees

captan
Cyprex
ethion
Karathane
Difolatan
ferbam
zineb
Kelthane
Plictran
Polyram
Benlate
methoxychlor
phygon
sulfur
Sayfos
Omite
Torque

GUIDE FOR SPRAYING TREE FRUITS

The procedures for efficient use of orchard sprayers are contained in Publication 373, Orchard Sprayers. Though this information was derived mostly from apple orchards, the general principles of spray information, and the operation and maintenance of equipment apply equally well to spraying of peaches, pears, plums and cherries. The following points should be stressed:

1. The sprayer must be large enough to cover the orchard in the time available and under adverse conditions.
2. Equipment must be in top condition.
3. Trees must be pruned so that the spray will penetrate easily.
4. Regular checks must be kept on severity of disease, insect pest numbers and stages, and lengths of wetting periods, so that timing will be accurate.
5. Rates per hectare listed in this publication are based on maximum effective dilute rates for large, standard apple trees with moderate populations of pests and diseases. Use the suggested rate of chemical per hectare in the volume per hectare given by the manufacturer of the sprayer. Reductions in chemical per hectare may be made where pest numbers are low, but only after sufficient experimentation by the grower in his orchard. Some Ontario growers have had successful control with the following reductions:

   Trees 6 m and over — full recommended rate
   Trees 4.5-5.5 m — ¾ full recommended rate
   Trees 2.5-3 m — ½ full recommended rate
   Example: With captan at 9 kg/ha,
   ½ rate = 4.5 kg/ha.

   Note: Companies are not liable for failure due to use of rates below those recommended on their labels.
6. Both low volume applications and low rates of chemical have resulted in increased populations of scales, mites and woolly aphid, especially in treetops.

   For oil sprays, enough spray liquid must be used to soak the bark completely. Suggested volumes are as follows:

   Trees 6 m and over — 4500 L water/ha
   Trees 4.5-5.5 m — 4000 L water/ha
   Trees 2.5-3m — 3500 L water/ha

Calibrating the Sprayer

See page 24 of Publication 373, or follow this shortened version.

Refer to Table 2 on driving time per hectare.

Table 2. SPRAYING TIME PER HECTARE (Without turning & filling time)

Distance between rows (metres)	Time in minutes to drive one hectare at tractor speeds (kilometres per hour)						
	1.6	**2.4**	**3.2**	**4.0**	**4.8**	**5.6**	**6.4**
3.0	125.0	82.5	62.5	50.0	41.25	35.0	31.0
4.6	82.5	55.0	41.25	33.0	27.5	23.5	20.5
6.1	62.5	41.25	31.0	25.0	20.5	17.75	15.5
7.6	50.0	33.0	25.0	20.0	16.5	14.0	12.5
9.1	41.25	27.5	20.5	16.5	13.75	11.75	10.25
10.7	35.25	23.5	17.75	14.0	11.75	10.0	8.75
12.2	31.0	20.5	15.5	12.5	10.25	9.5	7.75

Proceed through the following seven steps:

1. Check tractor speed:

Table 3. TIME REQUIRED TO PASS A NUMBER OF TREES AT DIFFERENT DRIVING SPEEDS

Time (seconds) to pass 10 trees for different tree spacing (metres)					
6.1	**7.6**	**9.1**	**10.0**	**10.7**	**12.2**
91	114	136	150	159	182
68	85	102	112	119	136
54	68	82	90	95	109
45	58	70	77	82	94
39	49	58	64	68	78
34	43	51	56	60	68

For spacings of 3, 3.7 and 4.6 m, use half the time values for 6.1, 7.6 and 9.1 m.

2. Make a sprayer-tank measuring stick marked off in units of 50 L.
3. From the chart find the number of minutes needed to spray a hectare at the speed recommended for your sprayer.
4. Decide how many litres of liquid per hectare you wish to use (considering time available, size of sprayer, size of trees, and time of day spraying will be done).
5. Find the sprayer output required thus:

$$\frac{\text{litres per hectare}}{\text{time per hectare}} = \text{litres per minute (for all nozzles)}$$

6. Divide this output by the number of nozzles:

$$\frac{\text{litres per minute}}{\text{number of nozzles}} = \text{litres per minute per nozzle}$$

7. From manufacturers' chart* find a nozzle to give this output. Then choose nozzles with smaller outputs for top and bottom positions and larger ones for the upper third of each side. When added, the total output should be close to the value shown in No. 5 (L per min). For small trees, block off one or two of the top nozzles and shut off between trees to prevent waste of spray.

* Pages 40-47, Publication 373, *Orchard Sprayers.*

ABBREVIATIONS

ai = active ingredient
AP = agricultural powder
DP = dispersable powder
E = emulsifiable
EC = emulsifiable concentrate
F = flowable
e.g. = for example
Gr = granules, granular
% = percent (by weight)
SC = sprayable concentrate
SP = sprayable powder
W = wettable
WP = wettable powder

mm = millimetre
cm = centimetre
m = metre
km = kilometre
cm^2 = square centimetre
m^2 = square metre
ha = hectare
mL = millilitres
L = litre
g = gram
kg = kilogram
t = tonne
kPa = kilopascal
m/s = metres per second
km/h = kilometres per hour

METRIC CONVERSIONS FOR CONCENTRATE SPRAYING OF ORCHARDS

Tank Size		Acres sprayed with 1 tank at 3 rates: in gal/acre			Hectares sprayed with 1 tank at 3 rates: in L/ha		
GALLONS	**LITRES**	**20 gal/ac**	**60 gal/ac**	**100 gal/ac**	**225 L/ha**	**670 L/ha**	**1120 L/ha**
100	455	5.0	1.7	1.0	2.0	0.67	0.40
160	730	8.0	2.7	1.6	3.2	1.0	0.65
200	910	10.0	3.3	2.0	4.0	1.3	0.81
240	1090	12.0	4.0	2.4	4.8	1.6	0.97
300	1365	15.0	5.0	3.0	6.0	2.0	1.2
400	1800	20.0	6.7	4.0	8.0	2.7	1.6
500	2275	25.0	8.3	5.0	10.0	3.4	2.0

EXAMPLE

Tank size – 300 gal – 1365 L
Spraying rate – 60 gal/acre – 670 L/ha

Metric Recommendations

Ambush 850 g/ha
Polyram 6.75 kg/ha

Amount required per tank:
Ambush 850 g x 2.0 = 1700 g = 1.7 kg
Polyram 6.75 kg x 2.0 = 13.5 kg

Imperial Recommendations

Ambush 12 oz/acre
Polyram 6 lb/acre

Amount required per tank:
Ambush 12 x 5.0 = 60 oz ÷ 16 = 3.75 lb
Polyram 6 x 5.0 = 30 lb

To convert kg to lb multiply by 2.2
1.7 kg x 2.2 = 3.74 lb
13.5 kg x 2.2 = 29.7 lb

TABLE 4. COMPATIBILITY OF SPRAY MATERIALS

Where a blank appears on the chart, the materials can be used together.

□ Compatible
X – Do not use together
• – Not recommended together in this calendar
? – Compatibility unknown
OP – Organo-phosphorus compound

Do not mix pesticides with Streptomycin, thinning sprays or foliar fertilizers.

The chart applies only to the use of two, material spray combinations for deciduous fruit. **When three or more materials are tank-mixed together, further incompatibility may develop.**

Compatibilities of some materials may depend upon solvents and emulsifiers used by the manufacturer. Emulsifiable concentrate formulations are more likely to cause compatibility problems than wettable powders. **If wettable powders are mixed with emulsifiable concentrates, incompatibilities may result.**

Do not allow spray mixtures to sit overnight.

Dithane M-45 Manzate 200, Polyram and Zineb

	Ambush	Belmark	Benlate, Easout	Benlate or Easout + Captan	Benlate + Manzate or Polyram	bordeaux, fixed copper-lime	Botran	captan, folpet	Carzol	Cygon OP	Cyprex	Decis	diazinon OP	Difolatan	Dikar	Dithiocarbamates	DNOC (Elgetol) dinoseb	ferbam	Furadan	Guthion APM 50 OP	Imidan OP	Karathane	Kelthane	Lannate	malathion OP	methoxychlor (WP only)	Morestan	Omite	parathion OP	Phosdrin OP	Phygon	Pirimor	Plictran	rotenone	Rovral	Sevin	sulfur	Superior Oil (+ Sup. oil conc.)	Supracide OP	Systox	Thiodan	Zolone OP	Torque
Ambush																																											
Belmark	•																																										
Benlate, Easout																																											
Benlate or Easout + Captan		X	•																																								
Benlate + Manzate or Polyram			•	•																																							
bordeaux, fixed copper-lime	?	X	X	X	X																																						
Botran	?	?		•	X	X																																					
captan, folpet	10	10			•	1																																					
Carzol	?	?		?	?	?	?	?																																			
Cygon OP	?	?	4	?	?	X	X		?																																		
Cyprex				•	•	X			?																																		
Decis	?	?	?	X	?	?	?	X	?	?	?																																
diazinon OP	?	?				X	7			•		?																															
Difolatan			•	•	•	•	•	•	?	•	•	?	•																														
Dikar			•	•	•	•		•	?			?		•																													
Dithiocarbamates						•	X		?			?	9	•	•																												
DNOC (Elgetol) dinoseb	?	?	•	•	•	X	•	X	?	•	•	?	•	•	•	•																											
ferbam	?	?		•	•	X	•		?			?		•			•																										
Furadan	?	?		•	•	•	•		?	•	?	?	•	•	•	•	•	•																									
Guthion APM 50 OP	?	?				X		7				?	•	•			•	4	•																								
Imidan OP	?	?				X						?	•	•	2		•		•	•																							
Karathane	?	?	•	•	•	•	•		?	4		?		•			X		•																								
Kelthane		?				X		7	?		4	?		•			•		?			7																					
Lannate	?					X	•		?			?		•			•		•		•																						
malathion OP	?	?				X	7		?	•		?		•		9	•		•		•																						
methoxychlor (WP only)	?	?							?			?		•		7	•		•		•																						
Morestan		?		•	•	•	•		?	•		?	•	•			•	•	•	•	•	•	•	•	•	•																	
Omite		?				X			?	?		?		•			•		•				•	•			•																
parathion OP	?	?				3			?	•		?		•			•		•		•	4					•																
Phosdrin OP	?	?				X	X		?	•		?		•	?		•		•		•						•																
Phygon				•	•	X	•		?			?		•			X		•		•			?			•		X														
Pirimor		?				?	?		?	?	?	?	?		?		?	?	?			X	?	?	?	?	?	?	?	?	?												
Plictran						•			?	•		?		•			•		•				•	?			•	•		?		?											
rotenone	?	?	•	•	•	X	?		?	•		?		•			•		•		•			•		•	•				•	?	•										
Rovral		•		•	•	•	•	X	?	•	•	?	?	•		•	•	?	•			?	•	•	•	•	•	•	X	•	•	•	•	•									
Sevin	?	?				X						?		•			•		•								•			•					•								
sulfur	?	?	•	X	•			1	?		8	?		•			X		•			•		X			•					?											
Superior Oil (+ Sup. oil conc.)				X			•	1	?	X	5	?		X	X		X		•			X	•	•		X	X	X			X	?	•		•	?	X						
Supracide OP	?	?				?	?		?	?	X	?	?				?		?	?	?			?	?	?		?	?	?	?	?	?	?	•	?							
Systox	?	?				X	7		?	•	X	?		•			•		•								•		•		•	?			•								
Thiodan	?	?				X		7	?	•		?	•	•			•		•								•					?			?			6	?				
Zolone OP	?	?	2			X	9			•		?		•	2		•		•	•				•		•	•					?		•	?				?				
Torque	?					X	?		?	•	?	?		•			•		•				•	?		•	•	•		?	?	?	•	•	•	?	?	•		?		?	
Vydate		?				X						?		•			•	?																•	•			X	•				

1. Captan should not be used with or following oil, and not with or after sulfur on Delicious apples.
2. May cause injury on grapes.
3. Residual action reduced.
4. May cause injury under some weather conditions.
5. Consult manufacturer regarding suitable oil for combination to be used on apple. Do not use it later than half-inch green stage (see page 14).
6. Use EC formulations.
7. Use WP formulations.
8. Combination may cause necrotic spotting on Delicious.
9. Apply immediately with agitation.
10. When mixing captan with EC formulations of pyrethroids, add captan first. Apply immediately with constant agitation.

Table 5. NUMBER OF DAYS FROM LAST SPRAY TO HARVEST

Read the Label and Follow all Safety Precautions

Canada's Department of National Health and Welfare has established amounts of insecticides and fungicides that may remain on fruits at time of harvest. To avoid exceeding these tolerances, use recommended amounts and do not spray nearer to harvest than number of days shown below, or not later than stage indicated. This is subject to change by Information Letter as additional information is available. For tank mixes of two or more materials, use the longest time period given for any of the materials.

Do not apply a pesticide more often than recommended on the label.

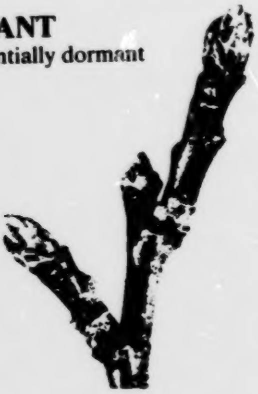
— pesticide not recommended in this calendar on this crop
X no tolerance for pesticide on that fruit
D dormant only
DD delayed dormant, half-inch green
PB prebloom
PH postharvest
C not later than recommeded in calendar
OP organo-phosphate

		Apple	Pear	Cherry	Peach and Nectarine	Plum	Grape	Black-berry Rasp-berry	Straw-berry	Apricot	Currant and Goose-berry
Ambush		7	7	—	7	—	21	—	—	—	—
APM 50	OP	7	7	15	21	—	28	—	—	—	—
Belmark		60	60	X—	X—	X—	X—	X—	X—	—	—
Benlate		1	1	1	1	1	7	1	1	1	—
Botran		—	—	—	1	—	—	—	—	—	—
captan		7	7	2*	2	2	7	2	2	2	—
captan-benomyl		7	—	—	2	2	—	—	—	2	—
Carzol		1	1	—	—	—	—	—	—	—	—
Cygon 480E	OP	14	14	15	40	X—	X—	X—	XC	—	—
Cyprex		7	7	7	—	X—	X—	X—	7	—	—
Decis		—	7	—	—	—	—	—	—	—	—
diazinon	OP	14	14—	10	20—	10	16	X—	5—	—	—
Difolatan		DD	—	—	D	—	—	—	—	—	—
Dikar		30	30	—	—	—	30	—	—	—	—
Dithane M—45		30	30	X—	X—	X—	X—	X—	X—	X—	X—
DNOC (Elgetol)		XD—	XD	XD—	XD—	XD—	XDD	X—	—	XD	—
Dyrene		—	—	—	—	—	—	—	5	—	—
Easout		1	—	1	1	1	—	1	1	—	—
ethion	OP	30	30	—	30	30	30—	—	8	15	—
ferbam		7	7—	4	21	7—	7	XC	—	21	14
Furadan		—	—	—	—	—	—	—	XC	—	—
Guthion	OP	7	7	15	21	15	28	7	5	21	—
Imidan	OP	1	1	7	1	1	7	X—	X—	—	—
Karathane		21	21	X—	X—	X—	30	X—	X—	—	—
Kelthane		7	7	7	14	7	7—	7	2	14	—
Lannate		8	—	—	—	—	—	—	—	—	—
Malathion	OP	3	—	3	7—	3	3—	1	3	7	3
Manzate 200		30	30	X—	X—	X—	30	X—	X—	—	—
methoxychlor		7—	7—	7	21	7	14—	—	14	21	14
Morestan		PB	PB	PB—	PB—	PB—	X—	X—	X—	PB—	—
Omite		7	PH	PH	14	28	28	—	3	—	—
parathion	OP	14	14	14	14	14	14—	—	14	14	—
Phaltan		1	X—	1	X—	X—	1	—	1—	—	7
Phosdrin	OP	2	2—	3	3	3	5—	3	1	—	—
Phygon		1	X—	3	shuck-split	3—	X—	X—	—	—	—
Pirimor		35	—	—	—	—	—	—	—	—	—
Plictran		14	14	—	7	—	—	—	7	—	—
Polyram		7	X—	—	X—	X—	45	X—	X—	—	—
rotenone		—	—	—	—	—	—	1	—	—	—
Sevin		7	7	1	1	1—	3	—	2—	3	—
Streptomycin sulfate		50	30	—	—	—	—	—	—	—	—
Sulfur		1	1	1	1	1	1	—	—	1	1
Supracide		XC	—	—	—	—	—	—	—	—	—
Systox	OP	21	21—	—	30—	60—	21—	PH	21—	—	—
Thiodan		15	15	15	15	15	30	X—	7	—	—
Torque		14	14	—	—	—	—	—	—	—	—
zineb		14	7	30	—	30—	30	14—	7—	—	7
Zolone	OP	1	7	7	7	14	14	—	—	—	—

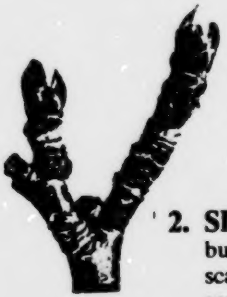
**5 days on Sour Cherry*

FIGURE 1. APPLE BUD STAGES

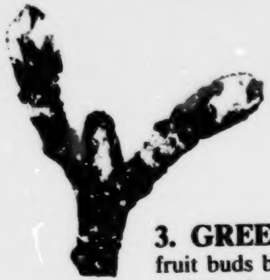
The prebloom bud stages have been renamed to help you time your sprays better. The renaming is based on recommendations by Dr. P.J. Chapman of the New York State Agricultural Experiment Station, Geneva, New York.



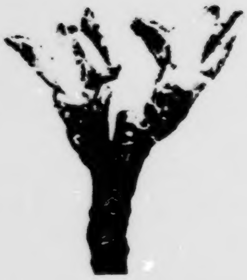
1. DORMANT
buds essentially dormant



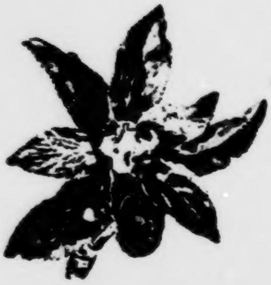
2. SILVER TIP
buds swollen and bud scales separated to expose some light gray tissue at tips



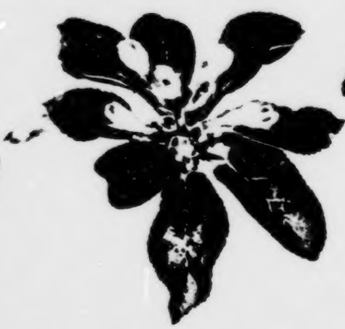
3. GREEN TIP
fruit buds broken at tips and showing about 1/16" green



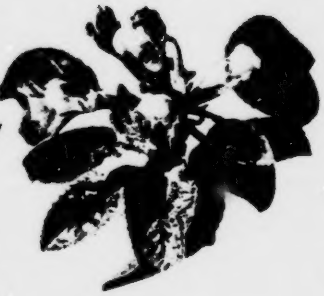
4. HALF-INCH GREEN
about ½" of new tissue projecting from fruit buds



5. TIGHT CLUSTER
blossom buds exposed but tightly appressed, stems short



6. PINK
all blossom buds in cluster pink, stems fully extended



7. FULL PINK
petals in blossom buds elongated, 1 to 3 days before open bloom

Table 6. RELATIONSHIP OF TEMPERATURE AND MOISTURE TO APPLE SCAB INFECTION*

Mean Temperature °C	Hours of Wetting for Infection Primary	Hours of Wetting for Infection Secondary
26	13	9
24	9	6
22	9	6
20	9	6
18	9	6
16	9	6
14	10	7
12	12	8
11	13	9
10	14	9
9	15	10
8	17	11
7	22	15
6	25	17
5	34	23
1-4	48+	32+

**Adapted after Mills.*

Table 7. RETENTION, REDISTRIBUTION AND AFTER-INFECTION ("ERADICANT") ACTIVITY OF SOME FUNGICIDES FOR CONTROL OF PRIMARY APPLE SCAB (ASCOSPORE STAGE ONLY)*

Materials	Maximum After-infection Activity 6°C	12°C	17°C	Retention	Redistribution
Benlate 50 WP (0.5 kg)	48 hr	24 hr	18 hr	Poor-fair	Unknown
Captan 50 WP (2 kg)	48 hr	24 hr	18 hr	Poor-fair	Fair-good
Phygon 50 WP (0.5 kg)	96 hr	48 hr	36 hr	Poor-fair	Poor-fair
Cyprex 65 WP (0.5 kg)	48 hr	24 hr	18 hr	Good	Good
Polyram 80 WP (2 kg)	48 hr	24 hr	18 hr	Good	Good
Dikar WP (2 kg)	48 hr	24 hr	18 hr	Good	Good

**Adapted after New York (Geneva) data 1974. (These values were obtained from greenhouse tests; rates quoted are per 1000 L. Rate per hectare is 3 times rate per 1000 L. The after-infection activity of these fungicides may not be adequate to control primary apple scab in a commercial orchard. Be very careful and don't rely heavily on the after-infection activity if the maximum time interval for a given temperature is being reached. The after-infection activity is calculated from the start of the wetting period.*

FUNGICIDE PROGRAMS FOR APPLE SCAB CONTROL

Apple scab control spray programs should begin when the first susceptible tissue emerges from the bud and the first ascospores are mature or discharged. Ascospores are produced in overwintered leaves that were infected the previous season. These ascospores start primary infections in the spring.

Programs for apple scab control are based primarily on timing of fungicide applications. There are three general approaches.

Protection Program

Commence between Silver Tip and Green Tip. Weather permitting, apply the first spray before the first mature ascospores are discharged. Apply fungicides at 5- to 7-day intervals up to First Cover, preferably on a pre-rain schedule. From First Cover up to early August, apply fungicides at 10-to 14-day intervals. New growth must be protected and residues washed off by rain must be replaced. Some fungicides, such as Polyram and Cyprex, are not readily washed off by rain and the residues are redistributed by rainwater from sprayed to unsprayed tissue (see Table 7).

Difolatan Single Application Technique (SAT)

For early season scab control a high rate of the protective fungicide **Difolatan is applied between Green Tip and Half-inch Green, before an infection has occurred.** Difolatan sticks tightly to twig surfaces but enough is redistributed by rainwater onto developing leaves to protect them from infection. Protection generally lasts through Pink and up to Petal Fall. Follow-up sprays of other fungicides are necessary from Petal Fall onwards. Under unseasonably wet weather conditions, start the follow-up fungicide program at Full Pink.

After-Infection ("Eradication")

A fungicide is applied at some time after an infection period has occurred, and the scab fungus has established in the leaf or fruit. The fungicides inhibit further growth of the fungus if applied soon enough after the infection. (See Table 7.) AFTER INFECTION CONTROL SHOULD NOT BE RELIED ON ENTIRELY for many reasons. The activity of post-infection fungicides is limited, and usually the period of time to apply them is one with severe conditions of high winds or further rain. Complete spray coverage is usually impossible, especially when small sprayers with limited wind capacity are used. Eradicant sprays are usually considered as emergency treatments, when the regular protectant program has been weak.

De-activation ("Anti-sporulant")

Once lesions of scab are found, many spores are present for further infections (secondary). Two materials, Benlate and Cyprex, have shown good anti-sporulant activity except where resistance has occurred. (See Resistance p. 16). If application at full rate is made as soon as lesions are found, and another application follows in five days, these materials will **help** to **reduce** this secondary spore production. These should be followed up with the regular protective program for scab control. Again, this anti-sporulant action should be considered for emergency only and reliance still based on the protective program.

Scab Control Under Adverse Weather Conditions

Several days of continuous rain and mild temperatures are very favorable for scab infection. It is often difficult to apply fungicides at critical times under such conditions. Because protective fungicide residues are diluted and largely ineffective during these rainy periods, after-infection sprays must somehow be applied to deactivate the fungus. **It is better to apply a fungicide during a break in the rain, or even during a light rain rather than not spraying at all.** A fungicide having good retention (sticking) properties should be used at such times. Polyram has good retention properties, with an after-infection activity of 18 hours at 16°C and 24 hours at 10°C. Benlate is poorly retained when applied to wet trees. Under cold weather conditions (0 to 4°C), the activity of Benlate has been questioned. If the time limit of the after-infection activity ("kick-back") of the fungicide is exceeded, apply the spray anyway, as soon as possible. Benlate can have anti-sporulant activity beyond the stated "After-Infection Activity" period in Table 7. Repeat the application in four to five days if wet weather persists. If an infection has occurred, spots should be visible in about 12 days if the temperature is about 20°C, and in about two to three weeks if temperatures are about 10 to 13°C or less. As soon as these spots are seen, apply two after-infection sprays about five days apart. These infections must be controlled or secondary spores will be produced. These spores may cause severe secondary infections during the next infection period.

Air-blast spraying is often impossible or hampered because of muddy ground. Fungicides applied by aircraft have provided successful control of apple scab. Aircraft application of Difolatan is not recommended at this time.

Strong winds may also interfere with spraying operations. Spraying at night when wind speeds usually diminish, and/or lowering the spray trajectory into the wind have been helpful.

Determining Infection Periods

In spring, ascospores of the apple scab fungus infect developing leaves and fruit. It takes about three weeks for these early infections to appear as spots (lesions). These spots are covered by "summer spores" (conidia) which will cause secondary infections. Secondary infections will occur in only two-thirds of the wetting time necessary for ascospore (primary) infections. Infection will occur only if moisture is present for a long enough period of time. The length of the wetting period necessary for infection is dependent on temperature. **To tell whether or not an "infection period" occurred, note the time from the start of a rain to the time the foliage dries.** This is the wet period. Calculate the mean temperature for this wet period. Periods of dew will also contribute to a wet period. However, this is only significant if preceded by rain. The rain is necessary to initiate the infection period. If rain occurs at 5 p.m. and the leaves remain wet all night with dew, the total period for the infection period is calculated from the 5 p.m. rain until the dew dries the following morning. If dew occurs at 11 p.m. and rain occurs at 6 a.m. while the leaves are still wet, the infection period is calculated starting at 6 a.m. until the leaves are dry. Calculate the mean temperature for the wet period starting at the beginning of the initial rainfall.

If, for example, the wet period is 11 hours and the mean temperature during this wet period is 13°C, a light primary infection and/or a moderately severe secondary infection have occurred. (See Table 6.) The longer the wet period over the minimum required for infection, the greater will be the severity of the infection. Wet periods during intermittent rain should be added together to determine an infection period, unless separated by 10 hours or more of dry sunny weather.

Before applying an after-infection fungicide, check the after-infection activity of the fungicide. If the after-infection activity is 24 hours at 12°C (see Table 7), then the fungicide can be applied anytime during the 12 hours (24 hours — 12 hours of wetting at 10°C = 12 hours) following the end of the infection period, provided any temperature change is negligible. A fungicide having a 48-hour after-infection activity at 12°C can be used during the 36 hours (48-12 hours = 36 hours) following the end of the infection period.

RESISTANCE OF APPLE SCAB FUNGUS TO CERTAIN FUNGICIDES

Resistance of the apple scab fungus to Cyprex, Benlate and Easout has resulted in the commercial failure of these fungicides in several widely distributed orchards in Ontario, and in the neighboring states of Michigan and New York. Cyprex resistance occurred after 10 years continuous usage and Benlate/Easout resistance after three years. Resistance has developed more slowly where these fungicides have been alternated or used as registered combinations with other fungicides. Once resistance to these chemicals is established in an orchard, it remains present in the orchard for years, even when the particular chemicals are not being used. This means that if these chemicals are re-introduced 5 to 10 years later as scab controls, they will fail.

When the buildup of resistance has begun in an orchard, switching to combination fungicides containing Benlate or Easout will not reverse or reduce this process. Combinations are effective in slowing down the development of resistance in orchards that have received little or no Benlate or Easout applied alone. Benlate and Easout should not be substituted for each other because resistance to one automatically means resistance to the other.

Check your orchard frequently and if you notice the beginning of a scab outbreak, immediately contact your Horticultural Crop Advisor for information about the Rapid Fungicide Resistance Diagnostic Service. The results of a test will show whether or not the protection failure is due to fungicide resistance and, it if is, alternative fungicides will be recommended.

Cyprex and Benlate/Easout represent two groups of fungicides with apple scab control activity. It is in the best interests of the fruit industry to use these fungicides knowledgeably, so as to minimize the development of resistance. Because of the increased development costs and stricter registration requirements, there may be few, if any, new fungicides to replace Cyprex, Benlate and Easout.

FIRE BLIGHT CONTROL PROGRAMS

Fire blight is a major problem for the grower of pears and susceptible apples in Ontario. Apple blossoms are affected most years; however, the most serious losses occur when branches and scaffold limbs of apple and pear are destroyed, reducing future fruit production potential. A number of practices are required in order to reduce blossom blight on apples, and shoot blight on both apples and pears.

If warm temperatures (18°C+) and rainfall occur during bloom, spray with 100 ppm streptomycin sulfate.* Repeat this spray if the wet condition persists. Spraying should be carried out under slow drying conditions (e.g. at night) for best results. Spraying following periods of rainfall and after hail injury can reduce shoot infections during the growing season (after petal fall). Caution is advised to ensure a 30-day to harvest interval on pear and 50-day to harvest on apple.

All diseased wood should be pruned out in the dormant season. New infections may be removed in the growing season, but this is not always practicable. Cut or break out infections at least 45 cm below any discolored wood. Disinfect any tools with one part Javex in four parts water. Store in a closed plastic or glass container. Wash tools and oil them to prevent rust. Denatured alcohol is a better disinfectant than the Javex solution and will not rust tools.

Insect pests such as aphids, psylla, leafhoppers and plant bugs should be controlled as they may transmit fire blight through their sucking and other activities in the orchard.

In a non-bearing orchard, Bordeaux (3-5-1000) may be substituted for streptomycin. However, it is less effective in its control of the disease.

It must be remembered that all these control methods should be carried out for best results in keeping fire blight to a manageable level in the orchard.

**Agri Mycin 17-100 ppm = 600 g product/1000 L water*
Agri Strep — 100 ppm = 375 g product/1000 L water

APPLES

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 9 Guide for Spraying.

Read the label and follow all safety precautions. **For dilute spraying, amount per 1000 L is one-third amount per hectare.**

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
GREEN TIP up to HALF-INCH GREEN	Scab Protectants			Consult Horticultural Crop Advisor for stage of spore development. Apply fungicide before spore release and keep growing leaves coated.
	single application technique	Difolatan 480 Flowable	45 L	For protection until petal fall (see page 15). Do not prune after application.
	OR Group A	(1) Polyram 80 W	6.75 kg	It is generally advisable to alternate materials in a spray program. Materials in Group B must be alternated with a material(s) in Group A. Materials in Group A can be used in seasonal programs. When used in a full season program, Dikar at 6.75 kg/ha will suppress orchard mites. Higher water volumes aid in mite suppression. Consult label. Manzate 200 and Dithane M-45 may cause fruit injury on Golden Delicious.
		(2) captan 50% WP	6.75 kg	
		or captan 80% WP	4.25 kg	
		(3) Phygon 50% WP	850 g	
		(4) Dikar WP	6.75 kg	
		(5) Manzate 200	6.75 kg	
		(6) Dithane M-45 80% WP	6.75 kg	

THE FOLLOWING RECOMMENDATIONS MAY NOT GIVE ADEQUATE DISEASE CONTROL WHERE THE APPLE SCAB FUNGUS IS RESISTANT TO BENLATE, EASOUT OR CYPREX. REPEATED USE OF BENLATE OR EASOUT COMBINATIONS, OR CYPREX ALTERNATED WITH OTHER FUNGICIDES, IS BELIEVED TO LEAD SLOWLY TO THE DEVELOPMENT OF RESISTANCE. FUNGICIDE RESISTANCE PERSISTS FOR MANY YEARS. IF FUNGICIDE RESISTANCE HAS BEEN CONFIRMED IN YOUR ORCHARD OR AN ADJOINING ONE, DO NOT USE THAT FUNGICIDE. REFER TO THE SECTION ON FUNGICIDE RESISTANCE (PAGE 16). CONSULT YOUR HORTICULTURAL CROP ADVISOR FOR INFORMATION ON THE RAPID FUNGICIDE RESISTANCE DIAGNOSTIC SERVICE AND HAVE YOUR SCAB SPORES TESTED.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
	Group B	(7) Captan-benomyl 60% WP	3.25 kg	Do not apply Benlate combinations on Golden Delicious, Rome and Stayman.
		(8) Benlate 50% WP	625 g	
		plus Polyram 80 W	3.25 kg	
		(9) Benlate 50% WP	625 g	
		plus captan 50% WP	3.25 kg	
		(10) Benlate 50% WP	550 g	
		plus Manzate 200	3.25 kg	
		(11) Easout 70% WP	625 g	
		plus captan 50% WP	3.25 kg	
		(12) Cyprex 65% WP	2.25 kg	Where injury problems with Cyprex have been experienced, use one of the other protectants.
	After-infection Spray ("Eradicants")	Use one of:		After-infection activity (See Table 7, page 15, 12°C.)
		(1) Phygon 50% WP	1.75 kg	48 hours. Apply this rate of Phygon only once a season.
		(2) Polyram 80 W	6.75 kg	24 hours.
		(3) captan 50% WP	6.75 kg	24 hours.
		or captan 80% WP	4.25 kg	
		(4) Dikar WP	6.75 kg	24 hours.
		(5) Cyprex 65% WP	3.25 kg	24 hours. Where injury or control problems with Cyprex have been experienced, use one of the other eradicants.

APPLES (Continued)

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 9 Guide for Spraying.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
	Red Mite Lecanium scale San Jose scale European fruit scale	superior oil (60-70 vis.)	65 L	Best scale control up until greentip, best mite control at half-inch green. Apply full rate of oil in 2200-4500 L of water, 4500 L will give best results.
			OR	
	Rosy aphid		35 + 35 L	Test the stability of the emulsion by shaking in a jar. Apply 35 L of oil per hectare twice before pink stage. **On large standard trees, use 90 L or 45 + 45 L.**
	Red Mite	superior oil concentrate	17 L	**For Red Mite only.** For compatibility with other chemicals consult label.
		OIL MAY CAUSE BARK INJURY ON RED DELICIOUS, EMPIRE AND MUTSU		
	Rosy aphid	Pirimor 50 WP	1.7 kg	
	Scab	With superior oil or superior oil concentrate use one of: (1) Polyram 80 W (2) Cyprex 65% WP (3) Dithane M-45 80% WP	 6.75 kg 2.25-3.25 kg 6.75 kg	Add fungicide to tank when 0.25 to 0.50 full of water and mix thoroughly. Add superior oil last when tank is at least 0.75 full of water. **Where control or injury problems with Cyprex** have been experienced, use one of the other fungicides. **See note for Group B above.** Dithane M-45 may cause fruit injury on Golden Delicious.
	Powdery mildew	Use one of: (1) Dikar WP (2) Karathane 18.25% WD (3) Sulfur 90-95% WP (4) Easout 70% WP (5) Benlate 50% WP plus Polyram 80 W (6) Benlate 50% WP plus captan 50% WP (7) Benlate 50% WP plus Manzate 200	 8.4 kg 3.5 kg 10.0 kg 1.5 kg 1.1 kg 3.25 kg (6.75) 1.1 kg 3.25 kg (6.75) 1.1 kg 3.25 kg (6.75)	Where mildew is a problem on varieties such as Idared, Jonathan, Cortland, and Tolman Sweet, spray at weekly intervals from bud burst until the terminal buds are formed (usually at 2nd cover). Do not use sulfur on Delicious. Dikar also controls scab. Materials (2), (3) and (4) must be used with one of the fungicides in Group A above for scab control. For scab control with mixtures (5), (6) and (7) use the higher rates in brackets.
	Tentiform leaf-miner	*(1) Ambush 25% WP or Ambush 500 EC *(2) Belmark 300 EC	850 g 400 mL 450 mL	Apply thorough spray coverage on trunk and scaffold limbs when eggs are observed on initial leaves. This treatment will also control early spring feeding caterpillars and tarnished plant bug. Further treatments may be required during the season because the leaf-miner is now resistant to Guthion, Imidan and Zolone. Consult Horticultural Crop Advisor.
		*Repeated applications are discouraged. See "*Pesticide Resistance*" page 7.		
TIGHT CLUSTER PINK	Scab	Use one of scab protectant fungicides listed in Green Tip except Difolatan. See page 15 for "adverse weather conditions."		

	Cedar apple rust Quince rust	Add: (1) ferbam 76% WP (2) Dikar WP (3) Polyram 80 W	 2.5 kg 6.75 kg 6.75 kg	In each spray up to and including FIRST COVER spray.
	Fire blight	(1) Agri Mycin 17 100 ppm (2) Agri Strep 100 ppm	600 g/1000 L 375 g/1000 L	High volume spraying preferrable. Use alone for best results. Also see page 16.
	Plant bugs	(1) Cygon 480 E (2) [1]Supracide 250 EC	2.5 L 6.7 L	Where troublesome, add to one spray before bloom. Will also control spring-feeding caterpillars and green fruitworm.
	Spring-feeding caterpillars Green fruitworm	Use one of: (1) [2]Guthion 50% WP (2) Zolone 30% WP (3) [1]Supracide 250 EC	 1.1 kg (425 g) 3.25 kg 6.25 L	Research experience has shown that lower rate of Guthion in brackets, which is lower than label rate, will control this pest complex at this time. This spray is not necessary if Ambush or Belmark was applied for tentiform leafminer.
FULL PINK	Scab	Use one of scab protectant fungicides listed in Green Tip except Difolatan. See page 15 for "adverse weather conditions."		
	Red Mite	Use one of: (1) Plictran 50 W (2) Morestan 25% WP (3) Kelthane AP-35 (4) Torque 550 SC (5) Carzol 92 SP	 1.25 kg 2.25 kg 4.5 kg 1.5 L 1.1 kg	Miticides are most effective when used alone. Use one of the miticides after consulting the agri-phone for stage of mite development. Morestan aids in powdery mildew control. Do not use Morestan if oil was used later than HALF-INCH GREEN. Carzol is harsh on beneficial mite species. Application before PETAL FALL is preferred.

IN ORCHARDS WHERE KELTHANE HAS BEEN USED FOR MANY YEARS (4-5 YEARS) EUROPEAN RED MITE HAS BECOME RESISTANT. ALSO IN A FEW ORCHARDS RED MITES ARE SHOWING SOME RESISTANCE TO PLICTRAN.

	Rosy aphid	Use one of: (1) [2]Systox 240 SC (2) Cygon 480 E (3) Zolone 30% WP (4) Pirimor 50 WP (5) [1]Supracide 250 EC	 3.25 L 4.25 L 3.25 kg 1.7 kg 6.25 L	See note on bee toxicity, page 9.
BLOOM PERIOD		**DO NOT APPLY INSECTICIDES WHILE APPLE TREES ARE IN BLOOM.**		
	Scab	Use one of protectant fungicides listed in Green Tip except Difolatan. See page 15 for "adverse weather conditions."		
	POLLINATION:	Most varieties are commercially self-unfruitful and require mixed variety plantings and insects for cross-pollination. Honeybees find apple blossoms attractive. See also page 8. Remove bees before applying CALYX spray.		
CALYX	Scab	Use one of the fungicides recommended in the GREEN TIP to HALF-INCH GREEN stage (except Phygon and Difolatan).		
	Tentiform leafminer	[1]Lannate L	6.75 L	For tentiform leafminer, control when the mines become visible on undersurface of initial leaves. Do not apply to early McIntosh or Wealthy apple varieties.

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[1] *Minimum period before reentry is 24 hours.*

[2] *Minimum period before reentry is 48 hours.*

APPLES (Continued)

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 9 Guide for Spraying.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
	Mullein leaf bug	(1) diazinon 50% WP	3.25 kg	Timing is critical. Spray immediately when nymphs are observed.
		*(2) Belmark 300 EC	450 mL	
		(3) [1]Lannate L	675 L	
		*(4) Ambush 25% WP	850 g	
		or Ambush 500 EC	400 mL	
	Oyster shell scale	(1) [2]Guthion 50% WP	2.1 kg	
		(2) [1]Supracide 250 EC	6.25 L	Apply as soon as petals are off.
When most petals have fallen	Plum curculio Caterpillars	Use one of:		
		(1) [2]Guthion 50% WP	2.1 kg	
		or 2APM 50 W	2.1 kg	
		(2) Imidan 50% WP	4.25 kg	
		(3) Zolone 30% WP	5.0 kg	
		*(4) Ambush 25% WP	850 g	
		or Ambush 500 EC	400 mL	
		*(5) Belmark 300 EC	450 mL	
		(6) [3]parathion 15% WP	6.75 kg	Parathion may injure McIntosh, Cortland, Empire and Melba.
FIRST COVER 7 to 10 days after CALYX	Scab	See page 15 for "adverse weather conditions." Use one of the fungicides recommended in Green Tip except Difolatan and Phygon.		An extra scab spray may be required between **CALYX** and **FIRST COVER** spray.
	Red Mite Two-spotted Spider Mite	Use one of:		
		(1) Plictran 50 W	1.25 kg	If this was your first mite spray repeat application in 7 to 10 days. Miticides are best used alone.
		(2) Kelthane AP-35	4.5 kg	
		(3) Torque 550 SC	1.5 L	
		(4) Carzol 92 SP	1.1 kg	Carzol is harsh on beneficial mite species.

IN ORCHARDS WHERE KELTHANE HAS BEEN USED FOR MANY YEARS (4-5 YEARS) EUROPEAN RED MITE HAS BECOME RESISTANT. ALSO IN A FEW ORCHARDS RED MITES ARE SHOWING SOME RESISTANCE TO PLICTRAN.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
	Plum curculio	Use one of the insecticides listed under CALYX		
SECOND COVER 10 days later	Scab	Use one of the fungicides recommended in Green Tip except Difolatan and Phygon.		
	Codling moth	Use one of:		
		(1) Sevin 50% WP	3.25 kg	
		or Sevin 85% WP	2.0 kg	
		(2) [2]Guthion 50% WP	2.1 kg	Guthion and APM also control scale crawlers.
		[2]APM 50 W	2.1 kg	
		(3) Imidan 50% WP	4.25 kg	
		(4) Zolone 30% WP	3.25 kg	Zolone also controls aphids.
		*(5) Ambush 25% WP	850 g	
		*(6) Belmark 300 EC	350 mL	

		Add one if aphids are abundant.		
		(1) Pirimor 50 WP	1.7 kg	Diazinon, Cygon and Zolone will also control codling moth.
		(2) [2]Systox 240 SC	2 L	Pirimor will also control white apple leafhopper.
		(3) Cygon 480 E	4.25 L	
		(4) Thiodan 50% WP	3.25-4.5 kg	Thiodan may also control white apple leafhopper. Check the label for recommended rate.
		(5) diazinon 50% WP	3.25 kg	
		(6) Zolone 30% WP	3.25 kg	Zolone will also control woolly apple aphid.
THIRD COVER	Scab	Use one of:		
10 days later	Group A	(1) Polyram 80 W	6.75 (5.0 kg)	If scab is controlled in your orchard use the lower rate given in brackets.
		(2) captan 50% WP	6.75 (3.25 kg)	
		or captan 80% WP	4.25 (2.25 kg)	
		(3) Dikar WP	6.75 (5.0 kg)	
		(4) Manzate 200	6.75 (5.0 kg)	Manzate 200 and Dithane M-45 may cause fruit injury to Golden Delicious.
		(5) Dithane M-45 80% WP	6.75 (5.0 kg)	

THE FOLLOWING RECOMMENDATIONS MAY NOT GIVE ADEQUATE DISEASE CONTROL WHERE THE APPLE SCAB FUNGUS IS RESISTANT TO BENLATE, EASOUT OR CYPREX. REPEATED USE OF BENLATE OR EASOUT COMBINATIONS, OR CYPREX ALTERNATED WITH OTHER FUNGICIDES, IS BELIEVED TO LEAD SLOWLY TO THE DEVELOPMENT OF RESISTANCE. FUNGICIDE RESISTANCE PERSISTS FOR MANY YEARS. IF FUNGICIDE RESISTANCE HAS BEEN CONFIRMED IN YOUR ORCHARD OR AN ADJOINING ONE, DO NOT USE THAT FUNGICIDE. REFER TO THE SECTION ON FUNGICIDE RESISTANCE PAGE 16). CONSULT YOUR HORTICULTURAL CROP ADVISOR FOR INFORMATION ON THE RAPID FUNGICIDE RESISTANCE DIAGNOSTIC SERVICE AND HAVE YOUR SCAB SPORES TESTED.

	Group B	(6) Captan-benomyl 60% WP	3.25 kg	
		(7) Benlate 50% WP	625 g	Do not apply Benlate combinations on Golden Delicious, Rome, and Stayman.
		plus Polyram 80 W	3.25 kg	
		(8) Benlate 50% WP	625 g	
		plus captan 50% WP	3.25 kg	
		(9) Benlate 50% WP	550 g	
		plus Manzate 200	3.25 kg	
		(10) Easout 70% WP plus	625 g	
		captan 50% WP	3.25 kg	
		(11) Cyprex 65% WP	2.25 kg	Where resistance or injury problems with Cyprex have occurred use one of the other fungicides.
	Codling moth apple maggot	Use one of:		
		(1) [2]Guthion 50% WP	2.1 kg	
		or APM 50 W	2.1 kg	
		(2) Imidan 50% WP	4.25 kg	
		(3) Zolone 30% WP	5.0 kg	
		(4) Cygon 480 E	4.25 L	Cygon is for processing apples only.
		(5) Sevin 50% WP	6.75 kg	
		or Sevin 85% WP	4.25 kg	
		(6) diazinon 50% WP	3.25 kg	
		•(7) Ambush 25% WP	850 g	
		or Ambush 500 EC	400 mL	
		•(8) Belmark 300 EC	350 mL	

DO NOT SPRAY CLOSER TO HARVEST THAN THE NUMBER OF DAYS GIVEN IN TABLE 5.

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[1] *Minimum period before reentry is 24 hours.*
[2] *Minimum period before reentry is 48 hours.*
[3] *Minimum period before reentry is 7 days.*
•Repeated applications are discouraged.
See "Pesticide Resistance" page 7.

APPLES (Continued)

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 9 Guide for Spraying.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
	Green apple aphid	**See under SECOND COVER.**		
FOURTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling moth apple maggot	Use one of the insecticides recommended for **THIRD COVER.** Cygon is for processing apples only. For early apple varieties observe the days to harvest interval (see Table 5.)		
FIFTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling moth apple maggot	Use one of:		
		(1) [2]Guthion 50% WP	2.1 kg	
		or [2]APM 50 W	2.1 kg	
		(2) Sevin 50% WP	6.75 kg	
		or Sevin 85% WP	4.25 kg	
		(3) diazinon 50% WP	3.25 kg	
		(4) Imidan 50% WP	4.25 kg	
		(5) Zolone 30% WP	5.0 kg	
		*(6) Ambush 25% WP	850 g	
		or Ambush 500 EC	400 mL	
SIXTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling moth apple maggot	Use one of the insecticides recommended for **FIFTH COVER.**		
	Sooty blotch and fly speck	Use one of:		
		(1) captan 50% WP	6.75 kg	Repeat application of captan in two weeks.
		or captan 80% WP	4.25 kg	
		(2) Benlate 50% WP	625 g	Both captan and Benlate will control Bull's Eye Rot. All materials provide some protection against other storage rots.
		plus captan 50% WP	3.25 kg	
		(3) Zineb 80% WP	4.25 kg	
		(4) Phaltan 50% WP	6.75 kg	
SEVENTH COVER Check on timing	Pinpoint scab and storage scab	Use one of the fungicides recommended for **THIRD COVER.**		Do not use fungicides closer than the stated preharvest interval.
	Second brood codling moth and apple maggot	Use one of the insecticides recommended for **FIFTH COVER.**		

SPECIAL SPRAYS	White apple leafhopper	(1) [2]Systox 240 SC	2.0 L	Spray when large numbers of nymphs (2-5 per leaf) are observed.
		(2) Pirimor 50 WP	1.7 kg	
		(3) [1]Phosdrin	850 mL	
		(4) Sevin 50 WP	3.25 kg	
		or Sevin 85% WP	2.0 kg	
		(5) Carzol 92 SP	1.1 kg	
	Bud moth Lecanium scale Red-banded leafroller	Use one of:		
		(1) [2]Guthion 50% WP	2.1 kg	See above for codling moth and apple maggot control.
		or [2]APM 50 W	2.1 kg	
		(2) Imidan 50% WP	4.25 kg	
		(3) [3]parathion 15% WP	5.0 kg	Do not use parathion on McIntosh, Cortland, Empire and Melba.
		(4) [1]Phosdrin	850 mL	
	Woolly apple aphid	Use one of:		High volumes of water are recommended. Spray coverage of trunk and scaffold limbs is essential. Repeat application in 14 days if woolly apple aphid is still present. Zolone is effective only if it is used in cover spray program. Pirimor will also control white apple leafhopper.
		(1) malathion 25% WP	6.75 kg	
		(2) Zolone 30% WP	3.25 kg	
		(3) Pirimor 50 W	1.7 kg	
	Red mite Two-spotted mite Rust mite	Use one of:		
		(1) Plictran 50 W	1.25 kg	Miticides are best used alone.
		(2) Omite 30 W	5.5 kg	
		(3) Kelthane AP-35	4.5 kg	
		or Kelthane 18.5 EC	8.5 L	
		(4) Torque 550 SC	1.5 L	
		(5) Carzol 92 SP	1.1 kg	Carzol is harsh on beneficial mite species.

IN ORCHARDS WHERE KELTHANE HAS BEEN USED FOR MANY YEARS (4-5 YEARS) EUROPEAN RED MITE HAS BECOME RESISTANT. ALSO IN A FEW ORCHARDS RED MITES ARE SHOWING SOME RESISTANCE TO PLICTRAN.

	Tentiform leaf-miner	(1) [1]Lannate L	6.75 L	Apply when new mines on the undersurface average one mine per leaf. Do not apply to early McIntosh and Wealthy.
		*(2) Ambush 25% WP	850 g	Apply when mines are visible on the upper leaf surface and moths are abundant.
		or Ambush 500 EC	400 mL	
		*(3) Belmark 300 EC	450 mL	Belmark should not be used within 60 days of harvest.

[1] *Minimum period before reentry is 24 hours*
[2] *Minimum period before reentry is 48 hours.*
[3] *Minimum period before reentry is 7 days.*
**Repeated applications are discouraged. See "Pesticide Resistance", page 7.*

Post Harvest Dips for Storage Rots (See page 70.)

GUIDELINES FOR PROTECTING YOUNG NON-BEARING APPLE PLANTINGS

The following program is designed to offer **limited protection when needed for newly planted trees.** It is not intended to be used for protection of bearing orchards. Other protective measures included removal of neglected fruit trees in the area, careful selection of intercrops (where used) and a clean, weed free environment. Rates are for dilute spraying. Alternate materials are available as shown in the calendar for bearing fruits.

APPLES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000 L	NOTES
FIRST SPRAY	Scab Powdery Mildew	Dikar WP	2 kg	When green tissue shows. Repeat at 7- to 10-day intervals if wet weather occurs until late June.
PREBLOOM	Leaf-feeding insects	Imidan 50% WP	1.25 kg	Before blossoms open in bearing orchards. Apply when caterpillars are small. Include with one of fungicide sprays.
BLOOM	Fireblight	(1) Agri-Mycin 17 (2) Agristrep	600 g 375 g	Avoid overstimulating growth. See page 16.
SUMMER SPRAYS	Aphids Leafhoppers	(1) Pirimor 50 WP (2) Cygon 480 E (3) [2]Systox 240 SC	500 g 1.25 L 625 mL	Spray if insects become abundant at any time.
	Tentiform leafminer	(1) [1]Lannate L (2) [1]Vydate L	2 L 3 L	Apply when mines are visible on underleaf surface.
	Mites	Plictran 50W	375 g	Check foliage frequently for mite injury. Spray if more than 5 mites/leaf are observed or at first sign of leaf bronzing.
	Buffalo treehopper			Follow clean cultivation or remove legumes from cover crop.

Root Lesion Nematode. See Page 73 for Post planting Treatment for nematodes on **NON BEARING** apples.

[1] *Minimum period before reentry is 24 hours.*
[2] *Minimum period before reentry is 48 hours.*

WEED CONTROL IN APPLES (Also see OMAF Publication 75, *Guide to Chemical Weed Control)*

WEEDS	MATERIALS AND RATES	NOTES (**Rates are per hectare actually treated unless otherwise stated**)
Most weeds and grasses	Amitrol T 240 g/L, Cytrol 240 g/L (amino triazole/ammonium thiocyannate) 4.5 L (product) in 300 L of water	Use as a spot treatment on actively growing weeds under established apple trees. For grass and poison ivy control, spray to wet all foliage. Keep the spray off tree trunks and leaves as much as possible. Do not use Amitrol T within 30 days before harvest. Cytrol is recommended on non-bearing trees only. May be combined with Sinbar or simazine.
	Amizine 60 WP (amitrole/simazine (1:3)) 7.7 kg (product) in 800 L of water per hectare	Apply after weeds emerge but before fruit starts to form (before 90% of petal fall). Should provide quick "knock-down" of weeds as well as leave a residue in the surface soil which will keep the treated area free of weeds for most of the growing season.
	Casoron 4 G (dichlobenil) 110 to 175 kg (product) per hectare or 67 g (product) on area 2 x 2 m	Apply in early spring or in the fall. The 67 g (product) rate is equivalent to 175 kg per hectare. Use only under trees planted over one year. Do not use on light sandy soils.
	*simazine 2.25 to 4.5 kg (active) in 300 to 1000 L water per hectare	Use only under trees planted one year or more. Use only once per season. Use higher rate on perennial grasses such as quack grass. Can be applied with paraquat.

	Sinbar 80 WP (terbacil) 2.25 to 4.5 kg (product) in 1000 L water per hectare	Use lower rate on soils with 1 to 2% organic matter, and higher rates on soils with more than 2% organic matter. DO NOT USE on coarse-textured soils or those with less than 1% organic matter. Use only under trees established for at least three years.
	**Several formulations available including:* *Simazine and Princep 80 WP at 2.75 to 5.5 kg/ha; Simadex 500 g/L at 4.5 to 9.0 L/ha;* *Princep-Nine-T at 2.5 to 5.0 kg/ha, Simadex 80 WP at 2.75 to 5.5 kg/ha.*	
Emerged weeds and grasses	Gramoxone 200 g/L (paraquat) 5.5 L (product) in 1000 L water per hectare or 55 mL in 10 L of water	Spray weed foliage until wet. More effective when applied on a dull, cloudy day or in the evening. More than one treatment may be required, since paraquat kills only emerged weeds through contact. Use on trees planted one year or more. Direct spray to avoid contact with leaves or green bark of trees. Paraquat can be applied in mixture with simazine or Sinbar, using same active ingredients given in table.
	Terraklene 500 g/L (paraquat/simazine 1:4) 5.5 to 11 L (product) in 500 L water per hectare	This commercial mixture can be used soon after weeds have emerged to provide a quick "knock-down" of weeds as well as a residue in the surface soil which will keep the treated area free of weeds for most of the growing season. Use only under trees established at least one year. Use the higher rate on heavy soils.
	*linuron 4.5 kg (active) in 400 to 600 L water per hectare	Use only under apple trees established at least 10 years.
Emerged grasses	Basfapon 74 SP, Dowpon M74SP (dalapon) 1.1 kg (product) in 100 L water	Use as a spot treatment on actively growing vegetation. Should be used in established orchards with no more than one treatment during the season. Spray until wet. Use only under apple trees established at least four years.
	Kerb 50 WP (propyzamide) 4.5 kg (product) per hectare (equivalent to 45 g per 100 m^2)	Apply from late September to early November when soil temperatures are low but above freezing. Use only under trees established for at least one year.
Bindweed and many other perennials	MCPB (Tropotox) 400 g/L or MCPB/MCPA (Tropotox PLUS 64) 2.5 L (product) in 800 to 1000 L water	May be mixed with paraquat. Use as directed spray under established trees as a spot treatment. Apply at low pressure (30 psi), as a coarse spray to wet leaves of bindweed, etc. Avoid contact with leaves, fruit, young growing shoots, suckers and green bark. See WEED CONTROL section, page 65.
Emerged annual and perennial weeds	Roundup 356 g/L (glyphosate) 2.25 to 3.5 L (product) per hectare for annual weeds, 4.75 to 7 L (product) for control of quackgrass, 7 to 11.5 L (product) for control of other perennial weeds in 200 to 400 L water per hectare.	Apply to actively growing weeds as a directed spray. For quack grass apply when grass has at least four new leaves. Canada thistle should be at least in early bud, milkweed at the bud, and bindweed at full flower for best results. **Remove all suckers before application. Do not allow spray or drift to contact leaves or green bark of trees.** Use preemergence herbicide to provide residual control of weed seedlings. Do not apply within 30 days of harvest. For site preparation use a broadcast spray and allow at least 5 days before tillage. Spray to thoroughly wet foliage but not to runoff.
	**Several formulations available including:* *Lorox 50 WP at 9 kg/ha; Afolan F, 450 g/L at 10 L/ha and Lorox L, 480 g/L at 9 L/ha.*	

CAUTION Simazine and terbacil residues high enough to harm many crops may persist for several years after removal of orchard.

APRICOTS

Read the label and follow all safety precautions.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	AMOUNT PER HECTARE	NOTES
DORMANT In late March or early April before buds swell	Red mite	Superior oil (see note)	20.0 L	60.0 L	Rate per 1000 L is based on 11.4 to 13.6 L of spray per mature tree.
PREBLOOM When blossom buds show pink	Brown rot Blossom blight	Use one of: (1) sulfur 90-95% WP (2) captan 50% WP or captan 80% WP	 6.0 kg 2.0 kg 1.25 kg	 18.0 kg 6.0 kg 3.75 kg	Apricots are extremely susceptible to brown rot at blossom time and just before picking.
SHUCK-SPLIT When about 50% of shucks have split	Brown rot Plum curculio	Use one of the fungicides listed under **PREBLOOM** Add one of: (1) [2]Guthion 50% WP (2) methoxychlor 50% WP (3) [3]parathion 15% WP (4) Sevin 50% WP or Sevin 85% WP	 625 g 3.0 kg 1.5 kg 2.0 kg 1.25 kg	 2.0 kg 3.0 kg 4.5 kg 6.0 kg 4.25 kg	Apricots are extremely susceptible to brown rot.
SHUCK-FALL 10 to 12 days after last spray	Brown rot Plum curculio	Use same materials as for **SHUCK-SPLIT.**			For peach tree borer refer to treatment as for peaches.
FIRST COVER 10 to 12 days after **SHUCK-FALL**	Plum curculio	Use one of the materials given for curculio in the **SHUCK-SPLIT.**			
The addition of Benlate 50% WP at 850 g to captan 50% WF at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.					
PRE-PICK	Brown rot	Use one of the fungicides listed under **PREBLOOM.**			Apricots are extremely susceptible to brown rot just before picking.

[2] *Minimum period for reentry is 48 hours.*
[3] *Minimum period before reentry is 7 days.*

Notes:

RED MITE: Where this mite has been a problem add Superior oil 20 L to each 1000 L in the **DORMANT SPRAY;** and in the **PREBLOOM** or at **SHUCK-SPLIT,** spray with one of Kelthane 35% AP 1.1 kg/1000 L or Kelthane 187.5 EC 2.5/1000 L; or Omite 30WP 2.25 kg/1000 L.

POLLINATION: Most varieties are self-fruitful and may be planted in solid blocks. Since this crop blooms early when the weather is often unreliable, it is advisable to provide honeybees to assist in pollen transfer.

VERTICILLIUM WILT: Do not plant following tomatoes, strawberries, potatoes, eggplants or peppers. Also do not interplant with these crops.

WEED CONTROL IN APRICOTS (Also see OMAF Publication 75, Guide to Chemical Weed Control.)

WEEDS	MATERIALS AND RATES	NOTES
Annual broad-leaved weeds and grasses	Gramoxone (paraquat) 5.5 L (product) in 1000 L water per hectare; or 55 mL per 10 L water	Treatment will kill many emerged annual weeds and grasses and some perennial grasses. Gramoxone can be used on trees planted one year or more. Keep the spray off leaves and green bark of trees. Several treatments may be required through the year. More effective when applied on dull cloudy days or in the evening. See WEED CONTROL section, page 65.

CHERRIES (SWEET AND SOUR)

Read the label and follow all safety precautions. **For dilute spraying, amount per 1000 L is one-third amount per hectare.**

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Sweet	AMOUNT PER HECTARE Sour	NOTES
DORMANT In spring when buds are dormant	Black cherry aphid (usually on Sweet Cherry only)	Elgetol (DNOC liquid)	17.0 L		If dormant spray could not be applied before buds started moving, use one of the alternate materials when buds are partially open, but before blossoms open.
OR AT BUD BREAK		Use one of:			
		(1) diazinon 50% WP	4.5 kg		A temperature of at least 21°C, thorough coverage and a calm day are needed for effective aphid control.
		(2) Thiodan 50% WP	4.5 kg		
		(3) Zolone 30% WP	4.5 kg		
PREBLOOM	Red mite (usually on Sour Cherry only)	Superior oil		65.0 L	Only needed in Sour Cherry orchards with a heavy mite population. Spray as buds are breaking. Apply oil at 3000 L/ha (dilute rate).
		or			
		Morestan 25% WP		2.25 kg	
	DO NOT APPLY INSECTICIDES WHEN CHERRY TREES ARE IN BLOOM See note on pollination page 8.				
BLOOM	Brown rot (stem rot and blossom blight stages)	Use one of:			
		(1) captan 50% WP	9.0 kg	6.75 kg	Spray just before blossom buds open. If wet weather prevails, this spray should be repeated.
		or captan 80% WP	5.5 kg	4.25 kg	
		(2) sulfur 90-95% WP	27.0 kg	20.25 kg	
		(3) Phygon 50% WP	2.25 kg	850 g	Do not use Phygon or captan following oil.
		(4) Phaltan 50% WP	—	6.75 kg	Do not use Phaltan on Sweet Cherry.
PETAL FALL	Leaf spot (Sour Cherry only)	Use one of:			
		(1) Cyprex 65% WP		1.75 kg	
		(2) captan 50% WP		6.75 kg	Spray only if rain is forecast between **BLOOM** and **SHUCK** sprays.
		or captan 80% WP		4.25 kg	
		(3) Phaltan 50% WP		6.75 kg	Do not use Phaltan or Cyprex on Sweet Cherry.
		(4) Benlate 50% WP		850 g	
		plus captan 50% WP		3.25 kg	
		(5) ferbam 76% WP		6.75 kg	

CHERRIES (SWEET AND SOUR) (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE		NOTES
			Sweet	Sour	
SHUCK	Plum curculio	Use one of:			Spray when most of the shucks are off.
		(1) [2]Guthion 50% WP	2.75 kg	2.00 kg	
		(2) Zolone 30% WP	4.5 kg	3.25 kg	Zolone also helps control aphids.
		(3) Imidan 50% WP	—	4.25 kg	Do not use Imidan on Sweet Cherry.
	Brown rot	Add one of:			
		(1) captan 50% WP	9.0 kg	6.75 kg	
		or captan 80% WP	5.5 kg	4.25 kg	
		(2) sulfur 90-95% WP	27.0 kg	—	Phygon is not effective for leaf spot.
		(3) Phygon 50% WP	2.25 kg	—	Do not use Phygon on Sour Cherry.
		(4) Phaltan 50% WP	—	6.75 kg	Do not use Phaltan on Sweet Cherry.
	Leaf Spot	Use one of the fungicides recommended at **PETAL FALL**, with the exception of ferbam.			
	Red Mite	Kelthane 35% AP		4.5 kg	Thorough coverage is necessary for good mite control.
		or Kelthane 187.5 EC		8.5 L	Only needed in heavily infested Sour Cherry orchards.
FIRST COVER 12 days after **SHUCK**	Plum curculio	Use one of the insecticides listed under **SHUCK.**			Zolone helps control aphids. Do not use Imidan on Sweet Cherry.
	Brown rot	Use one of the fungicides listed under **SHUCK.**			
	Leaf spot	Use one of the fungicides listed under **PETAL FALL,** with the exception of ferbam.			
SECOND COVER 12 days after **FIRST COVER**	Plum curculio Fruit flies (maggots)	Use one of:			
		(1) [2]Guthion 50% WP	2.75 kg	2.0 kg	On early varieties check interval from last spray to harvest date. See page 13. Spray when early varieties are beginning to color.
		or [2]APM 50 W	2.75 kg	2.0 kg	
		(2) diazinon 50% WP	4.5 kg	3.25 kg	
		(3) Zolone 30% WP	4.5 kg	3.25 kg	
		(4) methoxychlor 50% WP	13.5 kg	—	
		(5) Imidan 50% WP	—	4.25 kg	Diazinon and methoxychlor do not adequately control curculio.
	Brown rot	Add one of:			
		(1) captan 50% WP	9.0 kg	6.75 kg	
		or captan 80% WP	5.5 kg	4.25 kg	
		(2) sulfur 90-95% WP	27.0 kg	—	
		(3) Phaltan 50% WP	—	6.75 kg	Do not use Phaltan on Sweet Cherry.
	Leaf spot	Use one of the fungicides as recommended at **PETAL FALL,** with the exception of ferbam.			

	Powdery mildew	Use one of:			
		(1) Benlate 50% WP		1.1 kg	Sulfur at this rate will suppress powdery mildew. Higher rates may cause injury. Phaltan used to control brown rot will also help control powdery mildew.
		(2) Sulfur 90-95% WP		10 kg	
THIRD COVER	Fruit flies (maggots)	Use one of:			
		(1) Sevin 50% WP	9.0 kg	6.75 kg	Spray Sour Cherry about the time Montmorency is turning pink.
		or Sevin 85% WP	5.5 kg	4.25 kg	
		(2) Imidan 50% WP	—	4.25 kg	Spray Sweet Cherry 10 days after Second Cover.
		(3) Zolone 30% WP	4.5 kg	3.25 kg	
		(4) diazinon 50% WP	4.5 kg	3.25 kg	Check harvest interval before spraying early maturing Sweet Cherry. See page 13.
		(5) methoxychlor 50% WP	13.5 kg	10 kg	
	Leaf spot Brown rot	**Add** one of the fungicides listed under **SECOND COVER.**			
The addition of Benlate 50% WP at 850 g to Captan 50% WP at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.					
PRE-PICK (Sweet Cherry)	Brown rot	Use one of the fungicides listed under SECOND COVER for Sweet Cherry.			Spray each variety just before picking. Do not use Phaltan on Sweet Cherry.
POSTHARVEST ON FRUIT (Sweet Cherry)	Rhizopus rot (black whiskers)	Botran 75% WP	875 g per 500 L water		Dip harvested cherries in suspension of Botran and keep the mixture well agitated during use. Read directions on label.
POSTHARVEST	Leaf spot	Use one of:	SWEET	SOUR	Necessary where leaf spot is a problem.
		(1) Cyprex 65% WP	2.25 kg	1.75 kg	
		(2) captan 50% WP	9.0 kg	6.75 kg	
		or captan 80% WP	5.5 kg	4.25 kg	
		(3) ferbam 76% WP	9.0 kg	6.75 kg	
		(4) Phaltan 50% WP	—	6.75 kg	Do not use Phaltan on Sweet Cherry.
		(5) Benlate 50% WP	1.1 kg	850 g	
		plus captan 50% WP	4.5 kg	3.25 kg	
	Powdery mildew	Benlate 50% WP		1.1 kg	
	Red mite	Use one of:			
		(1) Morestan 25% WP	2.25 kg	1.75 kg	If mites can easily be found on the leaves at this time, add a miticide with your fungicide application. Do **NOT** mix Morestan with any other product.
		(2) Omite 30% WP	6.75 kg	5.0 kg	
		(3) Kelthane 35% AP	5.5 kg	4.5 kg	
		or Kelthane 187.5 EC	10 L	8.5 L	

[2]Minimum period before reentry is 48 hours.

Notes:

PEAR SLUG: If it appears on leaves of **non-bearing trees** in injurious numbers, spray Sevin 50% WP 1.0 kg per 500 L.

NEMATODES: See page 73 for methods of controlling nematodes when replanting old tree sites or whole orchards.

PEACH TREE BORER: Where a problem, spray as directed for **PEACH** (page 40).

APHIDS: In sour cherry orchards where black cherry aphids are regularly a problem, apply the dormant spray recommended for Sweet Cherries. If aphids threaten to become troublesome during the season, spray with one of:

(1) diazinon 50% WP
3.25 kg/ha
(2) Thiodan 50% WP
3.25 kg/ha
(3) Zolone 30% WP
3.25 kg/ha

They may be added to any of the sprays after bloom. Thorough coverage and a calm warm day are necessary for good aphid control.

BACTERIAL CANKER: This disease causes wilted blossoms, spotting and collapse of leaves on spurs and gumming of twigs. If this disease is suspected, consult Horticultural Crop Advisors for a spray program through September and October.

CHERRY YELLOWS VIRUS: Where a problem, Gibberellic acid (ACTIVOL GA) has been shown to increase fruit spur development. Use at the rate of 10 ppm (10 ACTIVOL GA tablets per 1000 L of water). Use 9 L of spray per tree. Higher rates may be required for old or less vigorous trees. AGRAL 90 at the rate of 113 g per 450 L of water is suggested as a spreader sticker. Apply the spray during the period 7 to 21 days after petal fall. Gibberellic acid must be applied every year to improve bud development and later shoot growth. Follow manufacturer's directions.

POLLINATION: Sour cherry is self-fruitful and may be planted in solid blocks of one variety. However, they do require insects for pollen transfer. Honeybees readily work this crop.

Sweet Cherry is self-unfruitful and requires inter-varietal plantings. Insects are essential for pollen transfer. Honeybees are excellent pollinators. Since the blossoms remain receptive for only a short time, bees should be moved into the orchard as soon as blossoming begins.

ALAR: Alar applied to the drip point at the rate of 0.9-1.36 kg (Sour) and 0.68-0.9 kg (Sweet) per 450 L of water, 10 to 16 days after petal fall (shuck split) has resulted in:

1. Advanced maturity of four to five days in the year of application.
2. Redder and more uniform color at full maturity.
3. Easier separation of fruit from fruit pedicels (stems) at full maturity.

Growers who are interested in trying it should keep the following points in mind:

a. Crop and fruit size may be reduced on low-vigor trees, or where cherry yellows virus is a problem.
b. Favorable effects from Alar will not be as evident after the second or third application, depending on orchard conditions.
c. When cherry yellows is an evident problem, Alar should not be used.

ETHREL: Ethrel is registered for commercial use as a chemical ripening and loosening aid. When applied according to manufacturer's directions the material tends to promote uniform maturity and loosens the fruit for easier mechanical harvest.

Follow the manufacturer's **precautions and directions** for best results.

Growers are particularly cautioned against the use of Ethrel on trees that have experienced severe stress such as drought, disease or winter injury. Ethrel applied to such trees frequently causes severe gummosis.

WEED CONTROL IN CHERRIES (Also see OMAF Publication 75, Guide to Chemical Weed Control.)

WEEDS	MATERIALS AND RATES	NOTES (**Rates are per hectare actually treated unless otherwise stated.**)
Annual broad-leaved weeds and grass	Casoron 4 G (dichlobenil) 110 to 175 kg (product) per hectare on area covered or 67 g (product) on 2 x 2 m area at base of tree	Used as a 4% granular material, preferably in late fall or early spring. Do not use on light sandy soils. For quack grass control, apply 175 kg (product) in late fall. Use only under trees planted over one year.
	*linuron 4.5 kg (active) in 400 to 600 L water per hectare of area sprayed	Apply as a directed spray before weeds are 12 cm high. Use only under trees established at least 10 years. Keep spray off leaves and green bark of trees.
	Gramoxone 200 g/L (paraquat) 5.5 L (product) in 1000 L water per hectare; or 55 mL (product) per 10 L water	Treatment will kill many emerged annual weeds and grasses and some perennial grasses. Gramoxone can be used on trees planted one year or more. Keep the spray off leaves and green bark of trees. Several treatments may be required through the year. More effective when applied on dull cloudy days or in the evening. See **WEED CONTROL** section, page 65.

Emerged annual and perennial weeds	ROUNDUP 356 g/L(glyphosate), 2.25 to 3.5 L (product) per hectare covered for control of annual weeds, 5.0 to 11.5 L/ha for control of perennial weeds in 200 to 400 L water per hectare	Glyphosate should be applied to actively growing weeds. For control of quack grass apply when grass has at least four new leaves on each shoot. Canada thistle should be at least in early bud stage, field bindweed at full flower, and milkweed at the bud stage. **Remove all sucker growth before application. Do not allow spray or drift to contact leaves or green bark of trees.** Use preemergence herbicide to provide residual control of weeds.

**Several formulations available including:*
Lorox 50 WP at 9 kg ha; Afolan F, 450 g L at 10 L ha
and Lorox L 480 L at 9 L ha.

GRAPES

See Chart "Relative Disease Susceptibility" at the end of the Grape Calendar.

Read the label and follow all safety precautions.

Amount per 1000 L is one-third amount per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
PHOMOPSIS SPRAYS	**See note (a) page 34 for effectiveness of fungicides for control of grape diseases.**			
	Phomopsis cane and leaf spot	Use one of:		Spray varieties where phomopsis is a problem, when new shoots are 1.25 to 5 cm long, and again when 10 to 15 cm long. Apply at least 1700 L of spray per hectare.
		(1) captan 50% WP	3.25 kg	
		or captan 80%	2.0 kg	
		(2) Phaltan 50% WP	3.25 kg	
PREBLOOM	Berry moth	Use one of:		
		(1) ²Guthion 50% WP	1.1 kg	Spray shortly before bloom where berry moth has been a problem.
		or ²Guthion 240 SC	2.0 L	
		or ²APM 50 W	1.1 kg	Apply at least 1700 L/ha (dilute rate).
		(2) Sevin 50% WP	3.25 kg	For mealybug control use either Guthion 50% WP 1.1 kg or diazinon 50% WP 3.3 kg/ha.
		or Sevin 85% WP	2.0 kg	
		(3) Imidan 50% WP	2.0 kg	**WARNING:** Under slow-drying conditions or at temperatures above 240C, any spray material or combinations are likely to cause some degree of injury, especially to the variety Foch.
	Mealybug (see notes)	(4) Zolone 30% WP	2.5 kg	
		(5) Ambush 25% WP	550 g	
		(6) Diazinon 50% WP	1.75 kg	
	Downy mildew (see note (a) at end of Grape Calendar.)	Add one of:		Spray Buffalo, Fredonia, President, Van Buren, French Hybrid and vinifera varieties. If bloom is delayed or if wet weather is expected, repeat the application. Check combinations for compatibility. See Table 4.
		(1) Phaltan 50% WP	3.25 kg	
		(2) captan 50% WP	3.25 kg	
		or captan 80% WP	2.0 kg	
		(3) Polyram 80% WP	3.25 kg	
		(4) Dikar WP	3.25 kg	
		(5) mancozeb 80% WP	3.25 kg	Combinations of Dikar and Zolone may cause severe burn and defoliation on Foch and Chelois. Do not use concentrations at less than 730 L/ha.
	Black rot	Use one of:		Susceptible varieties include Catawba, Concord, Agawam, Niagara, Pinot Chardonnay, Ventura, Dutchess. Refer to disease susceptibility chart for susceptibility of cultivars.
		(1) ferbam 76% WP	3.25 kg	
		(2) Dikar WP	3.25 kg	
		(3) Benlate 50% WP	850 g	

²Minimum period before reentry is 48 hours.

GRAPES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
	DO NOT APPLY INSECTICIDES WHEN GRAPES ARE IN BLOOM See note on pollination page 8.			
POSTBLOOM	Berry moth Leafhoppers	Use one of:		IMMEDIATELY BLOOM IS OVER, for effective control of berry moth, apply at least 2200 L/ha (dilute rate).
		(1) [2]Guthion 50% WP	1.5 kg	
		or [2]Guthion 240 SC	2.75 L	
		or [2]APM 50 WP	1.5 kg	For mealybug control, high-volume sprays are necessary; use either Guthion 50% WP 1.5 kg or diazinon 50% WP 4. 5 kg/ha.
		(2) Sevin 50% WP	4.5 kg	
	Mealybug (see notes)	or Sevin 85% WP	2.75 kg	
		(3) Imidan 50% WP	2.75 kg	
		(4) Ambush 25% WP	550 g	Repeated applications of Ambush are not encouraged.
		(5) Zolone 30% WP	3.25 kg	
		(6) diazinon 50% WP	2.25 kg	
	Grape Phylloxera (leaf form)	Add: Thiodan 50% WP	2.25 kg	Only French hybrid and vinifera varieties are susceptible to this pest. Thiodan may cause injury to Concord, Cascade, Baco, Seibel 8357 and Seibel 7053 (Chancellor).
	Downy mildew Black rot	Add one of:		Spray all varieties for mildew at this time. Repeat spray for black rot where it is a problem.
		(1) Phaltan 50% WP	4.25 kg	
		(2) Captan 50% WP	4.25 kg	
		or Captan 80% WP	2.75 kg	
		(3) Polyram 80% WP	4.25 kg	
		(4) Dikar WP	4.25 kg	
		(5) mancozeb 80% WP	4.25 kg	
	Powdery mildew	Use one of:		
		(1) sulfur 90-95% WP	9.0 kg	A program for powdery mildew is most effective when started at this time. DO NOT use sulfur on Concord, Foch, Van Buren or de Chaunac. SEE warning under **PREBLOOM.**
		(2) Karathane 22.5% WP	1.1 kg	
		(3) Dikar WP	4.5 kg	
		(4) Benlate 50% WP	1.1 kg	
	Botrytis bunch rot			**See note c at the end of GRAPE calendar.**
FIRST COVER 12 days after POSTBLOOM	Berry moth	Use one of:		
		(1) [2]Guthion 50% WP	1.75 kg	Where berry moth is a regular problem, apply one of these materials at a rate of 2800 L (dilute) per hectare.
		or [2]Guthion 240 SC	3.1 L	
		or [2]APM 50 W	1.75 kg	
		(2) Sevin 50% WP	5.5 kg	
		or Sevin 85% WP	3.25 kg	Thorough spraying reduces chance of a late second brood.
		(3) Imidan 50% WP	3.25 kg	
		(4) Ambush 25% WP	550 g	Repeated applications of Ambush are discouraged.
		(5) Zolone 30% WP	4.25 kg	
		(6) diazinon 50% WP	2.75 kg	

	Phylloxera (leaf form)			Repeat as in **POSTBLOOM SPRAY.**
	Downy mildew Powdery mildew Black rot	Add one of: (1) Phaltan 50% WP (2) Captan 50% WP or Captan 80% WP (3) Polyram 80% WP (4) Dikar WP (5) mancozeb 80% WP	 5.50 kg 5.50 kg 3.25 kg 5.50 kg 5.50 kg 5.50 kg	Repeat spray for black rot where it is a problem.
SECOND COVER 10 days after **FIRST COVER**	Powdery mildew	Use one of: (1) sulfur 90-95%WP(21days) (2) Karathane 22.5%WP(30days) (3) Dikar WP (30 days) (4) Benlate 50% WP (7 days)	 11.0 kg 1.5 kg 5.5 kg 1.5 kg	DO NOT use sulfur on Concord, Foch, de Chaunac or Van Buren varieties. For effective control of powdery mildew apply at least 2800 L/ha (dilute rate). Do not apply fungicides any closer to harvest than the interval states.
	Black rot	Use one of: (1) ferbam 76% WP (2) Dikar WP (3) Benlate 50% WP	 4.50 kg 4.50 kg 1.25 kg	Repeat spray for black rot where it is a problem. For effective control, apply at least 2800 L/ha (dilute rate).
	Botrytis bunch rot	Rovral 50% WP	1.5 kg	To minimize the development of resistance it is strongly suggested that only two applications of Rovral be made per season, these being in late July and mid-August as bunches are closing. See note c at the end of the Grape calendar.
FURTHER COVER SPRAYS	Powdery mildew (see note (d).	Use one of the materials listed under **SECOND COVER** and check for interval to harvest.		Varieties such as Concord, Niagara, Elvira and Fredonia are not as susceptible to this disease and extra sprays are usually not needed. Susceptible varieties such as Agawam, Delaware, French hybrid, New York Muscat, Seneca and vinifera cultivars often require extra sprays at 10-DAY intervals.
	Berry moth about August 20	Use one of the materials listed under **FIRST COVER** and check for interval to harvest.		A spray may be needed on late varieties to control the brood which emerges in late August.
	Botrytis bunch rot	Rovral 50% WP	1.5 kg	See note c at the end of the Grape calendar.

[2] *Minimum period before reentry is 48 hours.*

a. EFFECTIVENESS OF FUNGICIDES FOR CONTROL OF GRAPE DISEASES:

Fungicide	Phomopsis cane and leaf spot	Black rot	Downy mildew	Powdery mildew	Botrytis bunch rot
Phaltan	+++	++	+++	++	+
Captan	+++	++	+++	0	+
Dikar	+	+++	+++	+++	0
ferbam, mancozeb	+	+++	+	0	0
Sulfur	0	0	0	+++	0
Benlate	+	++	0	+++	0
Karathane	0	0	0	+++	0
Rovral	0	0	0	+	+++
Copper-lime	+	++	++	++	0

RELATIVE DISEASE SUSCEPTIBILITIES

This chart provides a relative rating of cultivar susceptibility under average conditions. Under adverse weather conditions, i.e. extended cool weather, any given cultivar may be more seriously affected.

Blank – relative susceptibility is unknown
+ = slight susceptibility
++ = moderately susceptible
+++ = highly susceptible
*This disease is more serious adjacent to bush areas or where there is poor air drainage

1 = sulfur sensitive
2 = Dikar + Zolone combination may be phytotoxic
3 = Dikar sensitive
4 = Karathane sensitive
5 = Thiodan sensitive

CULTIVAR		RATING OF SUSCEPTIBILITY TO DISEASES					CHEMICAL SENSITIVITY (PHYTOTOXICITY EXPERIENCED)
	Eutypa (dead arm)	Phomopsis (cane and leaf spot)	Black Rot*	Downy Mildew	Powdery Mildew	Botrytis Bunch Rot	
Labrusca							
Agawam	+	++	+++	+++	++		
Canada Muscat			+	++	+++		
Canadice					+		
Catawba	+	+	+++	+++	++		
Concord	+	++	++	++	++		1,4,5
Delaware	++		++	+++	++	+	4
Dutchess	++	++	++	++	++	+	
Elvira	+++	+++	++	+	++	++	
Festivee					++	++	
Fredonia	+	++	++	+++	++	+	
Van Buren	+			+++	++		1
Veeblanc (V53263)			++		++	++	
Himrod					++		

N.Y. Muscat	+		+		+++		
Niagara	++	++	+++	+++	++	+	
Veeport	+	+	+		+++		
Ventura	++	++	++		++	+	
Vincent		+			+++		
Vivant (63331)	+	+	++	++	++	+	
V 50201	++	+		+++	++		
Vinifera							
Chardonnay			++	++	+++	+++	3,4
Riesling		+	+	++	+++	+++	
Gamay			+	++	+++	++	
French Hybrids:							
Aurore		++	+	+	+++	++	4
Baco Noir			+		++	+	4,5
Chambourcin (J.S. 26205)					++	+	
Chancellor (S7053)			+	+++	+++	+	1,4,5
Chelois (S10878)	+++		++	+	+++	+	3,4
Couderc Muscat (C-29935)			++		+++	+	
de Chaunac (S9549)	+	+++	+	+	++	+	1,4
Foch	++	++	+		++	+	1,2,3,4
Le Commandant (BS2862)	+		++		++	+	2
Rosette (S1000)			++	+	++	+	4
Seyval Blanc (SV5276)		++	++	++	+++	++	
Verdelet (S9110)	+				++		
Vidal 256		+	+		++	+	4
Villard Noir (SV 18-315)					++		3

b. **FIXED COPPER:** Fixed copper 50-53% WP 750 g and hydrated lime 3000 g will help control powdery mildew, when used for control of downy mildew on the less susceptible varieties, but is not sufficiently effective on varieties which are very susceptible to powdery mildew. (Harvest interval on wine grapes is 30 days.) The fixed copper and lime mixture will not control powdery mildew but is involved in hardening of the plant tissue thereby making it less susceptible. Copper cannot be used on French hybrid or vinifera varieties, and is NOT compatible with any of the presently recommended insecticides. It may be used, however, when no insecticides are being applied.

c. **BUNCH ROT:** Many of the vinifera and vinifera hybrid cultivars with tight bunches are susceptible to Botrytis bunch rot, e.g. Gamay, Riesling, Chardonnay, Chancellor, Aurore and Seyval Blanc. Rovral is the only fungicide currently registered for control of bunch rot, but already Rovral-resistant Botrytis cinerea has been found in several Ontario vineyards where Rovral has been used. Benlate cannot be recommended because of the widespread distribution of Benlate-resistant botrytis in vineyards. The only alternatives are Captan and Phaltan which have moderate to good activity, but their use against bunch rot is not currently registered.

To minimize the devlopment of resistance to Rovral it is strongly proposed that only two applications of Rovral be made per season, and these should be made in late July and mid-August as bunches are closing. On late-harvested cultivars, a third application in early September may protect ripening berries from direct infection during wet weather. To obtain adequate spray coverage during mid and late summer use at least 900 L of spray per hectare. The protection of clusters from Bloom to mid-July may be obtained by the use of captan, Phaltan and possibly Dikar, at the rates recommended for the control of downy mildew given under First Cover.

d. **POSTHARVEST POWDERY MILDEW SPRAY:** The powdery mildew organism will attack leaves, fruit and canes of grape.

It has been observed that winterkill is more serious on infected canes. Bright sunny days and cool nights with heavy dews are ideal conditions for the continued spread of this disease. Susceptible cultivars include Aurora, Agawam, Delaware and many French hybrids and where powdery mildew infection is present on the leaves, growers are advised to apply one or two postharvest sprays to protect the wood for next year. Use sulphur, Benlate or Dikar according to manufacturer's directions.

POLLINATION: All commercial varieties grown in Ontario are self-fruitful and it is not considered necessary to provide honeybees for pollination.

Chemical Control of Fruit Set: Some grape varieties (usually labrusca types) frequently set too light a crop of fruit whereas others consistently set too heavily (often French hybrids). Chemicals are available to alter these effects. Alar will induce greater fruit set and Ethrel will cause flowers or young fruits to drop off. Ethrel is still in the experimental category for thinning, while Alar has been registered to alter fruit set.

Alar 85

1. The greatest increase in fruit set has occurred with Concord, Agawam and Fredonia. Little or no response can be expected on French hybrids.
2. Other varieties respond in varying degrees depending upon season and growing conditions.
3. Rates

Pruning Weight per vine	kg of Alar-85 per 1000 L	kg/ha
0.7 kg or less	DO NOT USE	—
0.9-1.4 kg	0.75-1.25	1.1-2.25
1.4-2.3 kg	1.25-2.0	2.25-3.25
2.3 kg or more	2.0-2.75	3.25-4.5

Experience with Alar is limited in some varieties. Growers who are interested in trying Alar should do so on a trial basis, keeping the following points in mind:

1. Alar requires a 12-hour rain-free period for absorption.
2. Applied between trace bloom and 50% bloom, Alar is effective in altering fruit set. Delayed applications will affect vegetative growth but not fruit set.
3. Apply as a dilute spray pending further research on concentrate spraying.
4. Do not mix with pesticides.
5. Alar should only be applied once during the growing season.
6. Livestock should not be grazed on vineyard cover crops treated with Alar.
7. Always leave some unsprayed vines to assess the effectiveness of the Alar treatment.

WEED CONTROL IN GRAPES (Also see OMAF Publication 75, *Guide to Chemical Weed Control.*)

WEEDS	MATERIALS AND RATES PER HECTARE	NOTES (**Rates are per hectare actually treated unless otherwise stated**)
Germinating weeds	Karmex (diuron) 4.5 kg to 6.7 kg (product) per hectare first treatment; 2.25 kg (product) for maintenance in 300 L water per hectare	Use only in established vineyards (at least three years old). Apply to 1 m strip under vines. The higher rate may be necessary to control heavy weed growth on heavy clay and/or high organic matter soils. The 2.25 kg rate should maintain a weed free condition if applied just before germination of weed seeds. Applications may be made in the spring, fall, or both, but the recommended rate should not be exceeded in any year.
	•simazine 3.6 to 4.5 kg (active) per hectare in at least 300 L water	Use only in established vineyards (at least three years old). Apply as directed spray to a 1 m strip under the vines. Established dandelions, field bindweed and quack grass will not be controlled. Provides effective control of plantain.
Emerged weed seedlings and grass	Gramoxone 200 g/L (paraquat) 5.5 L (product) in 1000 L water per hectare; or 55 mL (product) per 10 L water for spot treatment	Use as a directed spray to avoid leaves and young bark of vines. Use enough spray mixture to wet the leaves of the weeds. Better results are obtained if treatments are made on dull or cloudy days, or in the evening. This chemical can be used combined with the Karmex or simazine treatments mentioned above.
	Terraklene 500 g/L (paraquat) + simazine) in 500 L water per hectare	This commercial mixture can be used in vineyards established for at least one year. Apply as a directed spray on emerged weeds growing on the strip under the vines. See notes above for simazine and paraquat.
Annual weeds	Casoron 4 G (dichlobenil) 110 kg to 175 kg (product) per hectare	Apply in early spring or in fall. Apply only to dormant healthy vines established for at least two years. Apply in cool weather on moist soil.

Bindweed, plantain and many broad-leaved weeds and grasses	Gramoxone 200 g/L (paraquat) 5.5 L (product) plus MCPB (Tropotox) 400 g/L or MCPB /MCPA mixture (Tropotox Plus 400 g/L) 275L (product) in 1000 L water per hectare	Apply in late May or early June, or for bindweed control when bindweed starts to bloom. **MCPB** or **MCPB/MCPA SPRAY OR DRIFT CAN INJURE GRAPES.** Use only when necessary as a spot treatment (does not replace Karmex). Use a hand sprayer or hand-controlled wand fitted with a shielded nozzle. Use low pressure and direct spray to avoid contact with leaves and stems of grape vines. For small areas use 80 mL Gramoxone (product) plus 40 mL MCPB or MCPB/MCPA (product) in 10 L water per 375 m² of sprayed area.
Quack grass, bindweed thistles and other perennials	Casoron 4 G (dichlobenil) 175 kg to 225 kg (product) per hectare	Apply in the fall in cool weather on moist soil. Apply only to dormant healthy vines which have been established for at least two full years.
	Roundup 360 g/L(glyphosate) Quack grass 4.75 to 7L (product) Other perennials 7 to 12 (product) in 200 to **300 L water per hectare**	Apply as directed postemergent spray to control actively growing quack grass, bindweed, and many broadleaf and grassy perennial weeds. The higher rate is needed to control bindweed. Use preemergence herbicides to provide residual control of weed seedlings. Apply at or near grape bloom. **Direct spray to avoid leaves and green stems of grape vines.** Do not use on vines less than three years old.
	Roundup (glyphosate) as above	For site preparation apply to actively growing weeds. Quack grass can be controlled at the lower rate if it has at least four true leaves. Bindweed should be at full flower, milkweed at the bud stage, and Canada thistle has started to flower for best results. The higher rate may be needed to control these weeds. Spray to thoroughly wet but not to run off. Delay cultivation for at least five days after treatment. Planting can take place without further delay.

**Several formulations available including:*
Simazine and Princep 80 W at 4.5 to 5.5 kg/ha, Simadex 500 g/L at 7.5 to 9.0 L/ha,
Princep-Nine-T at 4.0 to 5.0 kg/ha, Simadex 80 WP 4.5 to 5.5 kg/ha.

CAUTION: Diuron and simazine residues high enough to injure many crops may persist for several years after removal of the vineyard.

PEACHES and NECTARINES

A Pest Management Program for Control of Insects Attacking Peach is Available (see page 8). Details May Be Obtained from your Horticultural Crop Advisor.

For dilute spraying amount per 1000 L is one-third amount per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
DORMANT In March or early April before buds swell	Leaf-curl only (Spring leaf-curl spray is not needed where a spray was applied last fall.)	Use one of: (1) ferbam 76% WP (2) DNOC liquid (Elgetol)	 6.75 kg 17 L	Delay may result in poor control of leaf curl. Oil may be added to the ferbam spray to control scale insects. Dilute ferbam in tank, then add oil. See note (a) at end of **PEACH** calendar.
	San Jose Scale	Add one of: (1) superior oil (2) Ethion superior oil	 65 L 65 L	Apply oil routinely every third year. If scale is a serious, or continuing problem, apply oil for at least two consecutive years.

PEACHES and NECTARINES (Continued)

For dilute spraying amount per 1000 L is one-third amount per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
PREBLOOM Half-inch Green to First Pink	Red mite	Use one of:		
		(1) superior oil	65 L	Preferred time to use oil for red mite control.
		(2) Ethion superior oil	65 L	
		(3) superior oil concentrate	17 L	
PINK THROUGH BLOOM	Blossom blight stage of brown rot	Use one of:		
		(1) captan 50% WP	6.75 kg	Spray when first blossoms are opening (late pink). Repeat at four-to-five-day intervals if weather is wet.
		or captan 80% WP	4.25 kg	
		(2) sulfur 90-95% WP	20.25 kg	
		(3) Phygon 50% WP	1.75 kg	
		(4) Rovral 50% WP	1.75 kg	Do not use Rovral in consecutive sprays. Alternate with other fungicides.
		(5) Funginex 190 EC	2.5 L	Make two to three applications from early to full bloom stage.
PETAL FALL	Red mite	Use one of:		
		(1) Plictran 50 WP	1.25 kg	
		(2) Kelthane 35% AP	4.5 kg	
		or Kelthane 187.5 EC	8.5 L	
	Mealy bug	(1) [3]parathion 15% WP	5 kg	Check for Mealy bug when shucks start to split and if necessary apply spray at 50% shuck split and repeat in 10 to 12 days. See Shuck Spray.
		(2) diazinon 50% WP	3.25 kg	
SHUCK SPRAY	Oriental fruit moth	Use one of:		
		(1) Imidan 50% WP	4.25 kg	Where Mealy bug is a problem, use parathion or add diazinon to one of the other materials. See Petal Fall Spray. Thorough spraying is essential to control Mealy bug.
		(2) [2]Guthion 50% WP	2.0 kg	
		or [2]APM 50 WP	2.0 kg	
		(3) [3]parathion 15% WP	5 kg	
		(4) Sevin 50% WP or	6.75 kg	
		Sevin 85% WP	4.25 kg	
		*(5) Ambush 25% WP	425 g	Repeated applications of Ambush are discouraged. See "Pesticide Resistance" page 7.
		or Ambush 500 EC	200 mL	
	Plum Curculio Use one of:			
		(1) [2]Guthion 50% WP	2.0 kg	
		or [2]APM 50 W	2.0 kg	
		(2) [3]parathion 15% WP	5.0 kg	
		(3) Imidan 50% WP	4.25 Kg	
		(4) Sevin 50% WP	6.75 Kg	
		or Sevin 85% WP	4.25 Kg	
		*(5) Ambush 25% WP	850 g	
		or Ambush 500 EC	400 mL	

	Red mite	If a dormant oil was not applied add one of: (1) Omite 30 WP (2) Plictran 50 WP (3) Kelthane 35% AP or Kelthane 187.5 EC	 5.5 kg 1.25 kg 4.5 kg 8.5 L	
	Tarnished plant bug	(1) Cygon 480 E *(2) Ambush 25% WP or Ambush 500 EC	1.75 L 850 g 400 mL	This spray may be necessary in Essex-Kent Counties where early season plant bug injury has been a problem. This spray is usually not necessary on the Niagara Peninsula. Some defoliation may occur under some conditions. See note (d).
	Lesser peach tree borer Peach tree borer			See note (b) at end of **PEACH** calendar.
SPECIAL SPRAY	Oblique-banded leafroller	Use one of: (1) Imidan 50% WP (2) [2]Guthion 50% WP or [2]AMP 50 WP	 4.25 kg 2.0 kg 2.0 kg	Where this pest has been a problem in past years, consult Horticultural Crop Advisor for proper timing.
	Tarnished plant bug	(1) Cygon 480 E (2) APM 50 WP or [2]Guthion 50% WP (3) Thiodan 50% WP *(4) Ambush 25% WP or Ambush 500 EC	1.75 L 2.0 kg 2.0 kg 4.5 kg 850 g 400 mL	Where this pest has been a problem in past years consult Horticultural Crop Advisor for proper timing. General timing is about mid-June. Where plant bug pressure is high, sprays may have to be repeated in 10-12 days.
FIRST COVER	Oriental fruit moth	Use same insecticide as in **SHUCK SPRAY**		See note (c) at end of **PEACH** calendar.
Spray all varieties about July 6. See spray service letters or call Agri-phone.	Brown rot	When spraying varieties maturing before Redhaven, add one of: (1) captan 50% WP or captan 80% WP (2) sulfur 90-95% WP (3) Rovral 50% WP	 6.75 kg 4.25 kg 20.25 kg 1.75 kg	See note (c) at end of **PEACH** calendar. See note in Pink through Bloom.
SPECIAL SPRAY	Red mite	If necessary, apply one of the miticides as in the **SHUCK SPRAY.** Examine each variety for mites three weeks before harvest. More than one mite per leaf (average) in mid-July can result in a mite infestation in August. Do not apply any of these miticides closer to harvest than in Table 5.		
SECOND COVER	Oriental fruit moth	Use one of: (1) Imidan 50% WP (2) Sevin 50% WP or Sevin 85% WP *(3) Ambush 25% WP or Ambush 500 EC	 4.25 kg 6.75 kg 4.25 kg 425 g 200 mL	Spray all varieties, Redhaven season and later about August 4. See spray service letters or call agri-phone. See note (c) at end of **PEACH** calendar.

** Repeated applications are not recommended. See "Pesticide Resistance" Page 7.* *[2] Minimum reentry period is 48 hours.* *[3] Minimum reentry period is 7 days.*

For dilute spraying amount per 1000 L is one-third amount per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
	Brown rot	Use the same as for **FIRST COVER,** above.		
	Red mite	The same as for **SPECIAL SPRAY,** above.		
THIRD COVER	Oriental fruit moth Brown rot	Use same material as for **SECOND COVER.**		Loring and later maturing varieties. Spray each variety 12 to 14 days before harvest. See note (c) at end of **PEACH** calendar.
	Red mite	Use the same as for **SPECIAL SPRAY,** above.		
The addition of Benlate 50% WP at 850g to captan 50% WP at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.				
HARVEST Just before picking each variety	Brown rot	Use one of:		
		(1) captan 50% WP	6.75 kg	In wet weather repeat applications between pickings.
		or captan 80% WP	4.25 kg	
		(2) sulfur 90-95% WP	20.25 kg	
		(3) Rovral 50% WP	1.75 kg	See note in Pink through Bloom.
	Rhizopus rot	Botran 75% WP	3.25 kg	
POSTHARVEST TREATMENT	Rhizopus rot (black whiskers)	Botran 75% WP	875 g/500 L water	Dip harvested peaches in a suspension. Keep suspension agitated while dipping. Read the label.
FALL SPRAY Preferred time to spray for leaf-curl	Leaf-curl	Use one of:		
		(1) Difolatan 480 F	17 L	Difolatan 480 F may be used before leaf drop is complete. One application only in early to late November. Use at least 750 L of spray per hectare.
		(2) ferbam 76% WP	6.75 kg	Any time after leaves are off in fall or winter when temperature in shade is above freezing, and conditions favor rapid drying.
		(3) DNOC Liquid (Elgetol)	17 L	
	X-Disease	Terramycin^R injection		See note (e) at end of **PEACH** calendar.

Notes:

A. **Oil and Ferbam: Ferbam** should be added to water in a partially filled tank **before oil** is added. With agitator running, sift ferbam slowly into water or, preferably, slurry in with water in a pail and then add to tank. Add oil last, as remainder of water is being added. To keep mixture uniform, do not stop engine until contents of tank are sprayed out. If oil is noticed floating on top of water, remix by turning a spray gun into tank. Injury may result to last few trees at end of tank if emulsion breaks.

B. **Lesser Peach Tree Borer and Peach Tree Borer:** Make three applications, the **first**—5 to 10 days after the **SHUCK** spray, the **second** —three weeks later, and the **third**—three weeks after the second. Apply the sprays with a gun and cover the trunk and scaffold limbs thoroughly. **In the first spray,** use Thiodan 50% WP 1.5 kg per 1000 L or Thiodan 4 EC 1.75 L per 1000 L or Endosulfan 400 EC 1.75 L per 1000 L. **In the second spray,** use Thiodan as above on all varieties **except** those in the Earlired, Cardinal, Dixired and Garnet Beauty season. On such varieties use malathion 25% WP 2.0 kg or Sevin 50% WP 2.0 kg per 1000 L. **In the third spray,** use Thiodan as above on all varieties **except** those in the Sunhaven, Redhaven, Golden Jubilee and Envoy season. On such varieties use the malathion-Sevin mixture as in the second spray.

Preplant Treatment: Some nurseries dip the roots and crown of peach trees in Thiodan, which gives complete control of peach tree borer in the first, and partial control in the second year after planting. If your trees were not treated at the nursery, dip the roots and crown in the following: either Thiodan 4 EC 1.25 L or Thiodan 50% WP 1.25 kg or Endosulfan 400 EC 1.25 L diluted with 100 L of water. The Thiodan wettable powder preparation must be stirred constantly to prevent settling out.

Special Precautions: Use rubber gloves to avoid exposing skin to insecticide. Dispose of excess material with extreme care. Thiodan is extremely toxic to fish and wildlife.

C. **Oriental fruit moth and brown rot sprays:**

1. Spray both bearing and young non-bearing peach trees, omitting fungicide on the non-bearing trees.
2. First and Second Cover Sprays – the suggested dates are approximate only. Timing in each area will depend on the development of the fruit moth in that area. Watch spray service letters for recommended dates.
3. Varieties maturing before Loring require two cover sprays. Loring and later maturing varieties require three cover sprays.
4. If weather conditions are unusual additional sprays may be necessary. Watch your spray service letters or listen to regular radio broadcasts.

D. **Plant Bugs:** Plant bugs overwinter in waste areas and may be numerous in peach orchards about blossom time, causing early injury or "catfacing." First generation adult plant bugs may also move into peach orchards from headlands or hay fields about the time alfalfa blooms, causing fruit gumming. To prevent "cat facing" apply Cygon 480 E at the Shuck Spray. To prevent fruit scarring and gumming apply one of the materials listed for plant bugs in the Special Spray.

Note: Cygon has caused some defoliation under certain conditions, e.g. cold wet soil and/or slow drying conditions during and following application. Least injury has occurred when sprays were applied in the morning while temperatures are moderate and drying conditions fairly good.

E. **X Disease:** May be transmitted to peach by leafhoppers flying from infected choke-cherry or cultivated cherry trees which may show no sign of having the disease. Infected peach trees decline quickly and die within a few years if not treated chemically. When the disease is detected in a tree, normal growth and fruiting can be restored by an application of Terramycin^{R} after harvest and before leaf fall. Best results may be obtained from September treatments and up to two years suppression of symptoms is possible. Follow manufacturer's label directions for injection method. See also OMAF Factsheet, X-Disease of Peach, Agdex 212/634.

F. **Other Formulations Available:** Aqua Parathion 800E may be used in place of 15% parathion WP; Guthion spray concentrate may be used in place of 50% Guthion WP. Follow manufacturer's directions.

PEACH CANKER – THE FOLLOWING PRACTICES AID GREATLY IN THE PREVENTION OF PEACH CANKER:

At Planting Time and First Year

1. Plant good nursery stock. Use thiodan dip for borer control. See note (b).
2. When pruning at planting time, remove all poor angles and weak side branches.
3. Treat all cuts immediately with a wound dressing.
4. Go over trees in mid-June and remove all dead wood and obviously poorly angled live branches.
5. Cut out cankers in June and treat with a wound dressing.
6. Apply sprays for fruit moth, peach tree and lesser borer.
7. Sow a cover crop (early July).
8. Protect from rabbits and mice.

Second Year and Following Years

1. Apply nitrogen fertilizers early (March, April) to bearing trees. Avoid late applications of manure.
2. Prune as late in the spring as possible. Prune two- and three-year-old trees after bloom.
3. Do not prune immediately preceding rains.
4. Remove all dead wood and poorly angled branches.
5. Treat pruning cuts in the main scaffold areas of the tree with a wound dressing.
6. Go over scaffolds in June and remove dead wood and poorly placed new growth.
7. In June cut out any cankers on scaffolds and treat with a wound dressing.
8. Apply sprays for fruit moth, peach tree borers, plant bugs and brown rot.
9. Sow a cover crop (early July).
10. Protect from rabbits and mice.

Use the following wound dressing:

Thiram-Latex Paint – as suggested for southwest injury (see page 72). It has shown to be effective wound dressing for peach trees at the Research Station in Harrow. (Use on a trial basis only.) Dissolve 400 g thiram 75% WP in 2 L of water. Add slowly to 4 L of good exterior white latex house paint and mix well.

NEMATODE CONTROL: See page 73.

ALAR applied to the drip point, at the rate of 1.5 to 2.0 kg per 1000 L three to seven weeks after petal fall, has resulted in:

1. Advanced maturity.
2. More uniform maturity.
3. Improved color.

Growers using this material should keep the following points in mind:

1. Varieties earlier than Redhaven do not have maturity advanced as much as later varieties.
2. Make application to early varieties three to five weeks after petal fall and to later varieties closer to seven weeks after petal fall.
3. Do not apply to low-vigor trees.

POLLINATION: All commercial varieties grown in Ontario are self-fruitful and may be planted in solid blocks. Bees readily work peach blossoms and frequently cause an over-set, which may necessitate thinning. For this reason, the placement of hives in peach orchards is not usually recommended.

Weed Control in Peaches and Nectarines (Also see OMAF Publication 75, Guide to Chemical Weed Control.)

WEEDS	MATERIALS AND RATES	NOTES (Rates are per hectare actually treated unless otherwise stated)
Annual broad-leaved weeds and grass	Casoron 4 G (dichlobenil) 110 to 175 kg (product) per hectare or 65 g (product) on area 2x2m	Use in late fall or early spring. For quack grass control, apply 175 kg (product) per hectare in late fall. Use only under trees planted over one year. **Do not use on light sandy soils.**
	*linuron 4.5 kg (active) in 400 to 600 L water per hectare	Apply as a directed spray before weeds are 12 cm high. Use only under trees planted over one year. Keep spray off leaves and green bark of trees.
	Gramoxone 200 g/L (paraquat) 5.5 L (product) in 1000 L water per hectare; or 55 mL (product) per 10 L water	Treatment may kill many emerged annual weeds and grasses and some perennial grasses. Gramoxone can be used on trees planted for one year or more. Keep the spray off leaves and green bark of trees. Several treatments may be required through the year. More effective when applied on dull, cloudy days or in the evening. May be used as a tank mix with linuron or Sinbar under established peach trees.
	Sinbar 80 WP (terbacil) 2.25 to 4.5 kg (product) in 1000 L water, per hectare	Use only under peach trees established three years or more. Once only per season. Apply lower rate on soils low in organic matter (1 to 2%) and the higher rate on soils with more than 2% organic matter. DO NOT USE ON COARSE-TEXTURED (SANDY) SOILS or soils with less than 1% organic matter. See WEED CONTROL section, page 65.
Emerged annual and perennial weeds	Roundup (glyphosate) 2.25 to 3.5 L (product) per hectare for annual weeds, 4.75 to 7 L (product) for control of quack grass, 7 to 12 L (product) for control of other perennial weeds in 200 to 300 L water per hectare	Apply to actively growing weeds as a directed spray. For quack grass apply when grass has at least four new leaves. Canada thistle should be at least in early bud, milkweed at the bud, and bindweed at full flower for best results. **Remove all suckers before application. Do not allow spray or drift to contact leaves or green bark of trees.** Use preemergence herbicide to provide residual control of weed seedlings.

**Several formulations are available including:*
Lorox 50 WP at 9 kg/ha; Afolan F 450 g/L at 10 L/ha and Lorox L 480 g/L at 9 L/ha.

PEARS

Read the label and follow all safety precautions. For dilute spraying amount per 1000 L is one-third amount per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
GREEN TIP	Scab	Use one of:		
		(1) Cyprex 65% WP	3.25 kg	It is important to start scab control early and repeat the spray if weather remains wet.
		(2) captan 50% WP	6.75 kg	
		or captan 80% WP	4.25 kg	
		(3) Dikar WP	6.75 kg	See note (3).

		(4) Benlate 50% WP plus Manzate 200	550 g 3.25 kg	Alternate Benlate-Manzate with full rates of captan, Cyprex or Dikar to avoid Benlate resistance.
	Red mite Pear psylla Scale insects	Use one of: (1) superior oil (2) ethion superior oil	 65 L 65 L	Best applied at or near green tip for mites. Good coverage necessary.
	Red mite only	Superior oil concentrate	17 L	
	DO NOT APPLY INSECTICIDES WHEN PEAR TREES ARE IN BLOOM. See note on Pollination page 8.			
PREBLOOM As blossom buds snow white at tips	Scab	Add one of the fungicides listed for Scab Control under GREEN TIP		Repeat spray if weather remains wet.
	Rust mite and red mite	Use one of: (1) Morestan 25% WP (2) Plictran 50 W (3) Kelthane 35% AP or Kelthane 187.5 EC (4) ethion 25% WP (5) Torque 550 SC (6) Carzol 92 SP	 2.25 kg 1.25 kg 4.5 kg 8.5L 6.75 kg 1.5 L 1.1 kg	Morestan is also effective against pear psylla at 6.75 kg/ha rate. Morestan should not be used within 14 days of oil. Some resistant mites may be present where Kelthane has been used for four or more years and an alternative miticide is advisable. See note (3) at end of **PEAR** calendar. Rust mite control must be started now. Carzol is harsh on beneficial mite species.
	Pear Psylla	(1) Ambush 25% WP or Ambush 500 EC (2) Belmark 300 EC (3) Morestan 25% WP	850 g 400 mL 450 mL 6.75 kg/ha	These materials will also control green fruitworm. Ambush may allow rust mite build-up. Repeated applications of Ambush and Belmark are not recommended. Morestan must not be used within 14 days of oil.
	Green fruitworm	Add one of: (1) [2]Guthion 50% WP or [2]APM 50 W (2) Zolone 30% WP (3) Imidan 50% WP	 2.1 kg 2.1 kg 3.25 kg 4.25 kg	
	Plant bugs	Thiodan 50% WP	3.25-4.5 kg	Check the label. Thiodan helps to control psylla.
	Fire blight	(1) Agri-Mycin 17 100 ppm (2) Agristrep 100 ppm	Rate/1000 L 600 g 375 g	High volume spraying preferable. Use alone for best results. Also see page 16.
PETAL FALL	Psylla Plum curculio	Use one of: (1) Ambush 25% WP or Ambush 500 EC (2) Belmark 300 EC (3) [2]Guthion 50% WP or [2]APM 50 WP (4) Imidan 50% WP (5) Zolone 30% WP	 850 g 400 mL 450 mL 2.1 kg 2.1 kg 4.25 kg 3.25 kg	Ambush is not registered for curculio but control has been observed. Repeated applications of Ambush and Belmark are not recommended.

[2] *Minimum period before reentry is 48 hours.*

PEARS (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
	Rust mite Red mite	Add one of the miticides listed in **PREBLOOM.**		Two, early season sprays are necessary for good mite control. Rust mite must be controlled by this time to avoid russeted fruit at harvest.
	Leaf spots Pear scab	Add one of the fungicides listed for Scab under **GREEN TIP.**		If weather is wet extra sprays will be needed for scab control before **FIRST COVER.**
	Mealy bug			See note (1) at end of **PEAR** calendar.
SPECIAL SPRAY	Oblique-banded leafroller	Use one of:		
		(1) Imidan 50% WP	4.25 kg	Where pest has been a problem, consult Horticultural Crop Advisor for proper timing. A second spray may be necessary in mid-August.
		(2) ^{2}Guthion 50% WP	2.1 kg	
		or ^{2}APM 50 W	2.1 kg	
		(3) Belmark 300 EC	450 mL	Belmark should not be used within 60 days of harvest.
FIRST COVER About June 25	Psylla	Use one of:		
		(1) Thiodan 50% WP	5-6.75 kg	Check the label.
		(2) Ambush 25% WP	850 g	Repeated applications of Ambush, Belmark and Decis are not recommended.
		or Ambush 500 EC	400 mL	
		(3) Belmark 300 EC	450 mL	
		(4) ^{2}Guthion 50% WP	2.1 kg	
		or ^{2}APM 50% WP	2.1 kg	
		(5) Imidan 50% WP	4.25 kg	Where plum curculio is a problem use one of the materials recommended under **PETAL FALL.**
		(6) Zolone 30% WP	3.25 kg	
		(7) Decis 2.5 EC	700 mL	
	Blister mite	Use one of:		
		(1) Sevin 50% WP	6.75 kg	
		or Sevin 85% WP	4.25 kg	
		(2) Thiodan 50% WP	3.25-4.5 kg	Check the label.
	Scab	Add one of the fungicides listed under **GREEN TIP.** Reduce rate of Cyprex to 2.25 kg/ha in cover sprays.		
SUMMER SPRAYS	Psylla (about July 10)	Use one of the materials listed under **FIRST COVER.** See notes.		An additional spray at this time may be necessary where low volume sprays are being applied.
	Mites (about July 15-20)	Use one of:		Red mite must be controlled to help prevent leaf scorch and keep foliage on trees. Examine orchards about July 15-20, and, if necessary apply one of the miticides. DO NOT APPLY closer to harvest than days shown.
		(1) Plictran 50%WP (14 days)	1.25 kg	
		(2) Kelthane 35% AP (7 days)	4.5 kg	
		or Kelthane 187.5 EC (7 days)	8.5 L	
		(3) ethion 25% WP 30 days	6.75 kg	
		(4) Torque 550 EC (14 days)	1.5 L	
		(5) Carzol 92 SP (1 day)	1.1 kg	Carzol is harsh on beneficial mite species.

SECOND COVER	Psylla Codling moth	Use one of the materials listed under **FIRST COVER.** or Sevin 50% WP or Sevin 85% WP	 6.75 kg 4.25 kg	 Sevin is not effective against older psylla nymphs.
	Sooty blotch	Add one of: (1) captan 50% WP or captan 80% WP (2) Zineb 80% WP	 6.75 kg 4.25 kg 6.0 kg	 Repeat spray for sooty blotch two weeks later.
SPECIAL SPRAY About mid-August	Oblique-banded leafroller	(1) Imidan 50% WP (2) [2]Guthion 50% WP or [2]APM 50 W	4.25 kg 2.1 kg 2.1 kg	Where pest has been a problem, consult Horticultural Crop Advisor for proper timing.

[1] Minimum period before reentry is 24 hours.
[2] Minimum period before reentry is 48 hours.

Notes:

1. **Mealy bug:** Where this has been a problem — spray at **PETAL FALL** and **FIRST COVER** with [3]parathion 15% WP 1.75 kg per 1000 L. A high-volume spray is necessary for good control.

2. **Mite Control:** Two, early season sprays are necessary for good mite control. Oil is not effective for the rust mite, but those miticides listed for **PREBLOOM** and **PETAL FALL** will control both the rust mite and European red mite.

3. **Dikar WP:** When used in a full season program **at 10-day intervals,** Dikar at 6.75 kg/ha will control pear scab and nymphal stages of pear psylla. It will also suppress red mite and rust mite populations. It must not be used within 30 days of harvest. Higher water volumes aid in mite suppression. Consult label.

POLLINATION: All varieties in Ontario are commercially self-unfruitful, and mixed plantings are necessary. Insects are required for cross-pollination. Honeybees do not find pear blossoms as attractive as most other fruits. Careful timing, and the use of pollen inserts will help to overcome this problem. See also page 8.

[3] Minimum period before reentry is 7 days.

GUIDELINES FOR PROTECTING YOUNG NON-BEARING PEAR PLANTINGS

The following program is designed to offer **limited protection when needed for newly planted trees.** It is not intended to be used for protection of bearing orchards. Other protective measures included removal of neglected fruit trees in the area, careful selection of intercrops (where used) and a clean, weed-free environment. Rates are for dilute spraying. Alternate materials are available as shown in the calendar for bearing fruits.

DISEASES AND INSECTS	MATERIALS		AMOUNT PER 1000 L	NOTES
Fireblight	(1) Agri-Mycin 17 (2) Agristrep	100 ppm 100 ppm	600 g 375 g	Avoid overstimulating growth. See page 16.
Pear Psylla	Morestan 25% WP		500 g	If nymphs are observed spray when 75% of the petals have fallen in a bearing orchard. Also controls mites.
Leaf-feeding insects	Imidan 50% WP		1.25 kg	Apply at any time when small caterpillars are feeding.
Pear Psylla (summer broods)	Thiodan 50% WP		1.5 kg	Apply when early nymphal stages are present.
European red mite	Plictran 50 W		375 g	Check foliage frequently and spray if more than 5 mites/leaf are observed or at first sign of leaf bronzing.

PEARS (Continued) **Weed Control in Pears** (Also see OMAF Publication 75, Guide to Chemical Weed Control.)

WEEDS	MATERIALS AND RATES	NOTES (Rates are per hectare actually treated unless otherwise stated)
Most weeds and grasses	Casoron 4 G (dichlobenil) 110 to 175 kg (product) per hectare or 65 g (product) on 2 x 2 m area	Apply in early spring or in the fall. The 65 g rate given is the same as 175 kg (product) per hectare. Use only under trees planted over one year. Do not use on light sandy soil.
	*simazine 2.25 to 4.5 kg (active) in 300 to 1000 L water per hectare on area covered	Apply before weed emergence. Use only on pear trees established at least one year. Use only once per season.
	**linuron 4.5 kg (active) in 400 to 600 L water per hectare	Use only under pear trees established at least 10 years.
Emerged weeds and grasses	Gramoxone 200 g/L (paraquat) 5.5 L (product) in 1000 L water or 55 mL (product) per 10 L water	Spray weed foliage till wet. More effective when applied on a dull, cloudy day or in the evening. Use on trees planted one year or more. More than one treatment may be required.
Emerged grasses	Basfapon 74SP, Dowpon M74SP (dalapon) 1.1 kg (product) in 100 L water	Use as a spot treatment on actively growing vegetation. Should be used only in established orchards with no more than one treatment during the season. Spray till wet. See WEED CONTROL section, page 65.
	Kerb 50 WP (propyzamide) 4.5 kg product per hectare	Apply from late September to early November when soil temperatures are low but above freezing. Use only under trees established for at least one year.
Emerged weeds	Terraklene 500 g/L (paraquat/simazine 1:4) 5.5 to 11 L (product) in 500 L water per hectare actually covered	This commercial mixture can be used in orchards established at least one year. Apply as a directed spray on emerged weeds. See notes above under simazine and paraquat.
Emerged annual and perennial weeds	Roundup 356 g/L (glyphosate) 2.25 to 3.5 L (product) per hectare for annual weeds, 5 to 7 L (product) for control of quack grass, 7 to 11.5 L (product) for control of other perennial weeds in 200 to 400 L water per hectare	Apply to actively growing weeds as a directed spray. For quack grass apply when grass has at least four new leaves. Canada thistle should be at least in early bud, milkweed at the bud, and bindweed at full flower for best results. Remove all suckers before application. Do not allow spray or drift to contact leaves or green bark of trees. Use preemergence herbicide to provide residual control of weed seedlings.

**Several formulations available including:*
Simazine and Princep 80 WP at 2.75 to 5.5 kg/ha; Simadex 500 g/L at 45 to 9.0 L/ha;
Princep Nine-T at 2.5 to 5.0 kg/ha, Simadex 80 WP at 2.75 to 5.5 kg/ha
***Several formulations available including:*
Afolan 50 WP and Lorox 50 WP at 9 kg/ha; Afolan F 450 g/L at 10 L/ha and Lorox L 480 h/L at 9 L/ha

PLUMS

Read the label and follow all safety precautions. For dilute spraying, amount per 1000 L is one-third amount per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
GREEN TIP Just as buds are bursting	Use one of: Red mite Scale insects	(1) superior oil (2) Ethion superior oil	65.0 L 65.0 L	Spray on a calm day to improve coverage. Apply 3300 L (dilute rate) per hectare.
	Red mite only	Superior Oil Concentrate	17 L	
PREBLOOM When blossoms show white	Brown rot	Use one of: (1) captan 50% WP or captan 80% WP (2) sulfur 90-95% WP	 6.75 kg 4.25 kg 20.25 kg	To help control brown rot, knock off mummied fruit when pruning. Also, cultivate entire orchard before bloom. Sulfur helps control Eriophyid mites on European plums and prunes. Captan may cause injury under some circumstances. Injury has occurred on Grand Prize, Early Golden, Shiro, Burbank and Ozark Premier.
	Black knot	Spray European plums, prunes and Damsons at weekly intervals starting at prebloom. There is no effective fungicide registered for black knot. However, several sprays from the bloom period through first cover of Benlate 50% WP at 1.1 kg/ha (full rate) tank mixed with captan 50 WP at 4.25 kg controls 'brown rot' where strains resistant to Benlate are not present, and has greatly reduced black knot. (See note on black knot, page 48.)		
	DO NOT APPLY INSECTICIDES WHEN PLUM TREES ARE IN BLOOM. See note on Pollination page 9.			
PETAL FALL When last of petals are falling	Red mite	Use one of: (1) Kelthane 35% AP or Kelthane 187.5 EC (2) Omite 30 W	 4.5 kg 8.5 L 5.5 kg	See note on **RED MITE** control at end of Plum calendar. Requires temperature above 21°C to be effective.
SHUCK When most of the shucks are off	Brown rot	Use one of: (1) Sulfur 90-95% WP (2) Captan 50% WP or captan 80% WP	 20.25 kg 6.75 kg 4.25 kg	See note page 9. Captan can cause leaf injury and spotting of the fruit on Japanese plums under some circumstances.
	Plum curculio	Add one of: (1) [2]Guthion 50% WP or [2]APM 50 W (2) Imidan 50% WP (3) [3]parathion 15% WP (4) methoxychlor 50% WP (5) Zolone 30% WP	 2.0 kg 2.0 kg 4.25 kg 3.25 kg 10 kg 3.25 kg	If temperatures are high, spray when the shucks split. Zolone will also control aphids.
		[2]Minimum period before reentry is 48 hours. *[3]Minimum period before reentry is 7 days.*		
SHUCK	Red mite	Add one of: (1) Kelthane 35% AP or Kelthane 187.5 EC (2) Omite 30% WP	 4.5 kg 8.5 L 5.5 kg	If oil was not used at **GREEN TIP** a second spray for mites is due at this time. See note on **RED MITE** at the end of Plum calendar.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
FIRST COVER 12 days after **SHUCK**	Brown rot Leaf spot	Use one of the fungicides listed under **SHUCK.**		
	Plum curculio	Use one of the insecticides listed under **SHUCK.**		
SUMMER SPRAY	Red mite	Use one of the miticides listed under **SHUCK.**		**See note on RED MITE** at the end of Plum calendar.
The additional Benlate 50% WP at 850g plus captan 50% WP at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.				
SECOND COVER	Brown rot	Use one of: (1) sulfur 90-95% WP (2) Captan 50% WP or captan 80% WP	 20.25 kg 6.75 kg 4.25 kg	 During wet weather repeat applications between pickings. Check interval to harvest for materials. See page 13.
PRE-PICK	Brown rot	Use one of the fungicides listed under **SECOND COVER.**		Check interval to harvest for materials.

Notes:

APHIDS: If they threaten to be a problem, spray with one of:

1. Thiodan 50% WP 3.25 kg/ha; 2. diazinon 50% WP 3.25 kg/ha; 3. Zolone 30% WP 3.25 kg/ha.

Very thorough coverage and calm, warm conditions are needed for good control.

PEACH TREE BORER: If a problem, spray as directed for **PEACHES,** see page 39.

POLLINATION: Both European and Japanese plums should be considered as self-unfruitful. Mixed plantings and insect pollinators are essential. Honeybees readily work plum blossoms.

BLACK KNOT: Destroy affected wild plums and neglected plums near orchard. Cut out and burn all black knots before March. Make the cut 15 cm below the swelling. Collect and burn all prunings bearing knots. **Knots left lying on the ground are a source of spores that start new infections.** Inspect all plums in early summer for new knots and those that were missed. Cut these out and burn them. Apply prebloom spray to all Damsons, European type plums and prunes.

APPLE MAGGOT: Where it has been a problem on prune, apply two or three sprays at 10-day intervals during July and early August. Consult Spray Service Circulars or Agri-phone for more details. Spray with one of:

1. diazinon 50% WP 3.25 kg/ha
2. [2]Guthion 50% WP 2.0 kg/(ha
   or [2]APM 50 W 2.0 kg/ha
3. Imidan 50% WP 4.25 kg/ha
4. Zolone 30% WP 5.0 kg/ha

HEAT SPOT: High temperatures may cause purplish spots on plum and prune fruits which exude clear gum. The spots develop about five to eight days after the hot spell. Summer cover crops and mulch help to reduce this physiological disease. Spraying with 4 kg/1000 L calcium chloride in mid-July and in early August has been demonstrated to reduce this disorder on prunes. Three sprays, 10-12 days apart, should be applied.

RED MITE: Mite control is difficult on plums and especially on prune varieties. Apply **GREEN TIP** and **PETAL FALL SPRAYS,** or **PETAL FALL** and **SHUCK SPRAYS,** using the recommended miticides. **SUMMER SPRAY** about mid-July, if mites are found on leaves of susceptible varieties (especially prunes); spray thoroughly with one of the miticides listed after first cover but not closer than the number of days allowed before harvest.

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[2] *Minimum period before reentry is 48 hours.*

WEED CONTROL IN PLUMS (Also see OMAF publication 75, *Guide to Chemical Weed Control.*)

WEEDS	MATERIALS AND RATES	NOTES (Rate is per hectare actually treated unless otherwise stated)
Annual broad-leaved weeds and grasses	*linuron 4.5 kg (active) in 400 to 500 L water per hectare	Apply as a directed spray before weeds are 12 cm high. Use only under trees established at least 10 years. Keep spray off leaves and green bark of trees.
	Gramoxone 200 g/L (paraquat) 5.5 L (product) in 1000 L water per hectare or 55 mL (product) per 10 L water	Treatment will kill many emerged annual weeds and grasses and some perennial grasses. Gramoxone can be used on trees planted for one year or more. Keep the spray off leaves and green bark of trees. Several treatments may be required through the year. More effective when applied on dull cloudy days or in the evening. See WEED CONTROL section, page 65.
	Casoron 4 G (dichlobenil) 110 to 175 kg (product) per hectare or 65 g (product) on 2 x 2 m	Use in late fall or early spring. Do not use on light sandy soils. For quack grass control, apply 175 kg (product) in early spring and in late fall. Use only under trees planted over one year.
Emerged annual and perennial weeds	Roundup (glyphosate) 2.75 to 3.5 L (product) per hectare for annual weeds, 7 to 5 L (product) for control of quack grass, 7 to 11.5 L (product), for control of other perennial weeds in 200 to 400 L water per hectare	Apply to actively growing weeds as a directed spray. For quack grass apply when grass has at least four new leaves. Canada thistle should be at least in early bud, milkweed at the bud, and bindweed at full flower for best results. Remove all suckers before application. Do not allow spray or drift to contact leaves or green bark of trees. Use preemergence herbicide to provide residual control of weed seedlings.

**Several formulations available including:*
Lorox 50 WP at 9 kg/ha; Afolan F 450 g/L at 10 L/ha and Lorox L 480 g/L at 9 L/ha.

RASPBERRIES AND BLACKBERRIES

Do not use Guthion, Phosdrin, or Systox in knapsack or other home garden-type sprayers.
Read the label and follow all safety precautions.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	AMOUNT PER 1000 LITRES	NOTES
	Do not spray closer to harvest than the number of days given in brackets. Unless otherwise stated use at least 2000 L of water per hectare.				
QUARTER-INCH GREEN	Anthracnose and Spur blight	DNOC liquid (Elgetol)	17.0 L	10 L	Use 1500 L of water per hectare.
PREBLOOM Just before blossoms open.	Anthracnose and Spur blight	ferbam 76% WP	4.5 kg	2.25 kg	

RASPBERRIES AND BLACKBERRIES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	AMOUNT PER 1000 LITRES	NOTES
	Powdery mildew	Use one of: (1) Benlate 50% WP (1 day) (2) Easout 70% WP (1 day)	 1.1 kg 1.1 kg	 550 g 550 g	In problem patches, spray when mildew is first observed. Repeat in 7 to 10 days. See page 7.
	Plant bug	[2]Guthion 50% WP (7 days)	1.5 kg	750 g	Repeat in 10 to 12 days.
	Raspberry sawfly	Rotenone 5% WP (1 day)	11.0 kg	4.5 kg	Repeat in 7 to 10 days.
	Raspberry fruitworm	malathion 25% (1 day)	4.5 kg	2.25 kg	Repeat in 7 to 10 days when bees are not working in the patch.
SEE PAGE 9 FOR WAYS TO REDUCE BEE POISONING.			**POLLINATION: These crops are self-fruitful but insects assist in pollination. The blossoms are highly attractive and are readily visited by honeybees.**		
BLOOM	Fruit rots on raspberries	Use one of: (1) captan 50%WP (2 days) or captan 80%WP (2 days) (2) Benlate 50%WP (2 days) plus captan 50%WP	 4.5 kg 3.25 kg 1.1 kg 4.5 kg	 2.25 kg 1.75 kg 550 g 2.25 kg	Repeat every 7 to 10 days to harvest. Because fungus can become resistant to Benlate captan is recommended.
SPECIAL SPRAYS When insects or mites first appear. Repeat as necessary.	Leafhoppers	Use one of: (1) [2]Guthion 50% WP (7 days) (2) [1]Phosdrin (3 days) (3) malathion 25%WP (1 day)	 1.5 kg 550 mL 4.5 kg	 750 g 225 mL 2.25 kg	Do not spray with insecticides when bees are working on berry blossoms.
	Two-spotted spider mite	Kelthane 187.5 EC (7 days)	9.0 L	4.5 L	
POSTHARVEST SPRAY As soon as crop harvest is complete.	Powdery mildew	Use one of: (1) Benlate 50% WP (2) Easout 70% WP	 1.1 kg 1.1 kg	 550 g 550 g	 Repeat at 14-day intervals. Repeat at 14-day intervals.
	Anthracnose and Spur blight	ferbam 75% WP	4.50 kg	2.25 kg	Remove old canes immediately after harvest.
	Aphids	[2]Systox 240 EC	3.0 L	1.5 L	Aphids spread virus diseases.
	Two-spotted spider mite	Use Systox as above or Kelthane 187.5% EC	9.0 L	4.5 L	

[1] *Minimum period before reentry is 24 hours.*
[2] *Minimum period before reentry is 48 hours.*

OTHER INSECTS AND DISEASES

1. **Viruses:** Virus diseases such as mosaic and leaf-curl are the main causes of low yields and poor quality fruit. The following steps will help minimize virus spread:

a. Plant virus-tested certified stock.
b. Destroy all nearby wild raspberries and blackberries.
c. Set new plantation at least 16.0 m from older plantations. Red raspberries should not be planted close to purple and black raspberries.
d. Rogue out and completely destroy all virus-infested plants as soon as symptoms of mosaic or leaf-curl appear.

2. **Cane Borer:** Canes girdled with two rings one-half inch apart. Examine canes frequently in June and July. Cut off wilted tips below lower ring, as they appear.
3. **Crown Gall:** Do not plant canes affected with crown gall. Avoid injury to crown and roots. Maintain high soil fertility.
4. **Orange Rust of Blackberry:** Bright orange pustules appear on lower surface of leaves. Dig out and destroy infected plants early in the spring before pustules break open.
5. **Sap Beetles:** Black beetles with cream markings infest berries in boxes. No chemical sprays give satisfactory control. Never put boxes of berries on ground. Remove from planting to screened building or shelter immediately after picking. For small plantings, use baits consisting of: (a) apple cider vinegar (1 L) plus 1 teaspoonful of either Sevin or Thiodan and place in small wide-screened jars throughout planting. Renew bait every few days; (b) mashed bananas or chopped up immature sweet corn and mixed with Thiodan 50% WP at the rate of 500.0 g per 25 kg; (3 level tablespoons per 1.0 kg) of ground material. Place bait on disposable pieplates (about 100 g per plate) and cover with second perforated plate. Distribute traps at 16.0 m intervals. Renew with fresh bait each week. Dispose of old bait and used pieplates by burying. KEEP BAIT OUT OF REACH OF CHILDREN, PETS AND LIVESTOCK.
6. **Verticillium Wilt (bluestem):** Do not plant following tomatoes, potatoes, eggplants, or peppers and do not interplant with these crops.

   Red raspberries: Cut out and destroy infected canes.

   Black and purple raspberries: Dig out and destroy infected plants.

   See page 73 for preplanting soil fumigation treatment.
7. **Cane Blight:** Canes wilt and die just before fruiting. Canes grayish. Most prevalent on canes weakened by insect and winter injury.
8. **Winter Injury:** Provide good drainage. Sow cover crop to check late growth. Do not cut canes back in fall.
9. **Nematodes:** Stunted, straggly canes. See page 73.
10. **Raspberry Crown Borer:** If more than 5% of the crowns are infested, apply a drench to the crown area. Infested planting should be treated for at least two years running.

Fall Treatment: Mid-September – mid-October: Drench crown area using Diazinon 50% EC 1.0 L (50% WP – 1.0 kg) per 1000 L of water. Apply 4000-5000 L of spray mixture per hectare. **Spring Treatment:** When new growth appears: apply treatment as above.

OTHER CULTURAL PRACTICES RECOMMENDED

a. Immediately when harvest is finished, remove and burn old canes, plus diseased and spindly new canes.
b. Plant on well-drained soil and on a site with good air circulation.
c. Space rows at least 2.5 m apart. Limit width to 0.5-0.6 m. Do not allow planting to become too dense.
d. Keep rows free from weeds.
e. In spring prune out and burn canes or portions of canes showing swelling, scars or cracks.

WEED CONTROL IN RASPBERRIES AND BLACKBERRIES

WEEDS	MATERIALS AND RATES	NOTES (**Rates are per hectare actually treated unless otherwise stated**)
Broad-leaved weeds	2,4-D Amine 550 g acid in 100 to 200 L water per hectare	May be used at any time of the year except when the plants are in blossom. Keep the chemical off the new shoots as much as possible. 1100 g/ha may be necessary to control established dandelions.
Germinating weeds	*simazine 1.8 to 2.25 kg (active) per hectare in 500 to 1000 L water	Apply as a directed spray early in the spring before weeds emerge. Keep the spray off young shoots. Do not use in first-year plantings.
Emerged annual weeds and grasses	Gramoxone 200 g/L (paraquat) 5.5 L (product) in 500 L to 1000 L water per hectare or 55 mL (product) per 10 L water	Direct spray near base of canes early in the spring before new shoots emerge, or in the fall when the canes are mature. Wet the weed foliage. This material is more effective when applied on dull days or in the evening. Provides temporary control of perennial grasses.

WEED CONTROL IN RASPBERRIES AND BLACKBERRIES (Continued)

WEEDS	MATERIALS AND RATES	NOTES (Rates are per hectare actually treated unless otherwise stated)
	Terraklene 500 g/L (paraquat + simazine) 5.5 L (product) in 500 L water per hectare	This commercial mixture can be used on established plantings only to control emerged weeds and provide residual control. See notes above concerning simazine and paraquat. Do not spray young raspberry shoots.
Quack or twitch grass	Basfapon 74SP, Dowpon M74SP (dalapon) 1.1 kg (product) in 100 L water	Spray on actively growing grass. Apply early in the year or in the fall. Direct spray to avoid new shoots.
Quack grass, perennial and annual weeds	Casoron 4 G (dichlobenil) 175 kg (product) per hectare or 65 g (product) per 2 x 2 m	Apply on established raspberry plantings in late fall. Do not cultivate or work into soil. DO NOT APPLY IN SPRING as injury may result.

**Several formulations are available including:*
Simazine and Princep 80 W at 2.25 to 2.75 kg/ha, Simadex 500 g/L at 3.6 to 4.5 L/ha, Princep-Nine-T at 2.0 to 2.5 kg/ha, Simadex 80 WP at 2.25 to 2.75 kg/ha.

STRAWBERRIES

Read the label and follow all safety precautions.

NEW PLANTING:
When spraying, use enough water to thoroughly wet plants.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
IN THE FALL BEFORE PLANTING	Verticillium wilt Nematodes	Vorlex Vapam	225 to 450 L 550 to 900 L	Treatment costly. Soil should be in seedbed condition, plant debris well-rotted, and soil temperature at 4°C or higher. To seal, cultipack or irrigate. See page 11.
	Nematodes only	Use one of: (1) Vorlex (2) DD (3) Telone II B	55 to 130 L 220 to 280 L 170 L	See page 73.
IN SPRING BEFORE PLANTING	White grub Wireworm	chlordane	1.1 - 2.25 kg (active) soil treatment, banded, apply at planting time.	**DO NOT PLANT STRAWBERRIES FOLLOWING SOD** since white grubs and wireworms are likely to be prevalent. **BECAUSE OF ROOT WEEVILS,** avoid planting strawberries adjacent to older plantings, particularly if fairly well-defined areas of stunted plants have been noted in these plantings. They may be infested with strawberry root weevil. Chlordane should be effective in controlling all three insects. Apply sprays in sufficient water to get good coverage. Disk into a depth of 10 to 13 cm immediately after application. Granular formulations may be drilled into the soil to a depth of about 10 cm.
	Root weevil	chlordane	5.5-11.0 kg (active). Broadcast: apply before planting, and work into the top 7-15 cm of soil.	

	Set out only vigorous, healthy certified plants, apparently free of June yellows and viruses.			
AFTER PLANTING	Cutworms	Use one of: (1) Sevin 50% WP or Sevin 85% WP (2) Poison bait	 2.25 kg 1.25 kg	**POISONED BAIT:** Thoroughly mix bran, 11 kg with Sevin 50% WP at 900 g or Sevin 85% WP at 540 g.Then moisten with water, about 10 L and mix thoroughly. Broadcast freshly prepared bait at dusk on a warm evening at 9 to 11 kg/ha. Sprays of Sevin will control above ground cutworms only.
1st or 2nd WEEK IN JUNE and again between AUG. 15 and AUG. 25	Strawberry leafroller Leafhopper	Use one of: (1) [3]parathion 15% WP (2) [2]Guthion 50% WP or [2]APM 50 W (3) malathion 25% WP	 1.75 kg 1.5 kg 1.5 kg 4.5 kg	Use sufficient water to wet plants thoroughly. Repeated applications will be necessary for leafhopper control.
ONE MONTH AFTER PLANTING and again ONCE OR TWICE AT 2-WEEK INTERVALS	Blight Scorch Leaf spot	Use one of: (1) bordeaux (2) Cyprex 65% WP	 5-5-1000 1.75 kg	Spray all varieties where Scorch has been a problem. Use sufficient water to wet plants thoroughly. Cyprex may injure Earlidawn plants.
		BEARING PLANTS (See Guidelines for Spraying Strawberries page 55)		
	DO NOT SPRAY closer to harvest, than the number of days indicated in brackets following materials (see Table 5).			
	Blight Scorch Leaf spot	Use one of: (1) bordeaux (2) Cyprex 65% WP (7 days)	 10-10-2000 L 1.75 kg	 Do not use with insecticides listed below. Cyprex may injure Earlidawn plants.
FIRST SPRAY WHEN BUDS ARE VISIBLE IN CROWN	Fruit rot (Botrytis)	Use one of: (1) captan 50% WP (2 days) or captan 80% WP (2 days) (2) Dyrene 50% WP (5 days) (3) Benlate 50% WP (1 day) plus captan 50% WP (2 days)	 6.75 4.25 3.25 1.1 kg 6.75 kg	Dyrene may cause foliage injury if used soon after a frost. Early season spraying is essential. Spray every 7 to 10 days. Reduce interval to three to five days during rainy periods. Captan gives short residual control under wet conditions.
	Because resistance of the Botrytis fungus to Benlate is widespread, growers are urged to use captan or Dyrene except under severe disease pressure, e.g. wet rainy periods, then use mixture (3) above.			
	Strawberry weevil (Clipper)	Use one of: (1) [2]Furadan 480 F (2) [4]Guthion 50% WP (3) malathion 25% WP	 1.1 L 1.1 kg 6.75 kg	Strawberry weevil may be active in the spring before mulch is removed. Use Furadan not later than first bloom because of its toxicity to pollinating insects. Furadan may remain toxic to beneficial insects for at least 10 days. Use Furadan only once during the season.
ABOUT FIRST WEEK IN MAY	Spittle bug	Use one of: (1) [2]Guthion 50%WP (5 days) or [2]AMP 50 W (5 days) (2) [1]Phosdrin (1 day) (3) Thiodan 50% WP (7 days)	 1.1 kg 1.1 kg 550 mL 1.1 kg	Guthion will also control strawberry weevil (blossom clipper). If spittle masses are aready numerous, use Thiodan or Phosdrin.

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[1] *Minimum period before reentry is 24 hours.*
[2] *Minimum period before reentry is 48 hours.*
[3] *Minimum period before reentry is 7 days.*

STRAWBERRIES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
WHEN FIRST BUDS SHOW WHITE	Fruit rot (Botrytis)	Use one of the fungicides listed for fruit rot in **the FIRST SPRAY.**		
	Strawberry weevil (Clipper)	Use one of: (1) [2]Guthion 50% WP (5 days) (2) malathion 25% WP (3 days) (3) methoxychlor 50% WP (14 days)	 1.1 kg 6.75 kg 4.50 kg	Use methoxychlor if blossoms have already opened.
		POLLINATION: Most varieties are self-fruitful but insects do assist in pollen transfer. **Honeybees are excellent pollinators.** **SEE PAGE 9 FOR WAYS TO REDUCE BEE POISONING.**		
FIRST BLOOM	Plant bugs	Use one of: (1) Cygon 480E (2) Thiodan 50%WP (3) [1]Phosdrin	 2.75 L 2.25 kg 550 mL	**DO NOT SPRAY WHEN BEES ARE WORKING, SPRAY IN EVENING.** Repeat Cygon spray in 10 to 12 days. Do not use more than two sprays of Cygon. If strawberry leafroller is a problem, use Phosdrin. Repeat in seven days.
	Fruit rot (Botrytis)	Use one of the fungicides listed for fruit rot in **the FIRST SPRAY.**		Keeping all flower parts coated with fungicide during bloom is essential to good control of Botyrtis.
7 TO 10 DAYS AFTER FIRST BLOOM and REPEAT 7 TO 10 DAYS LATER	Plant bugs	Use one of: (1) Thiodan 50%WP (7 days) (2) [1]Phosdrin (1 day)	 2.25 kg 550 mL	
	Fruit rot (Botrytis)	Use one of the fungicides listed for fruit rot in **the FIRST SPRAY.**		Shorten intervals to three days if weather is wet. Benlate will also control powdery mildew.
TO END OF HARVEST	Fruit rot (Botrytis) Leathery rot (Phytophthora)	Use one of: (1) captan 50% WP (2 days) or captan 80% WP (2 days) (2) Benlate 50% WP (1 day) plus captan 50% WP (2 days)	 6.75 kg 4.25 kg 1.1 kg 6.75 kg	If wet weather persists through harvest, use mixture (2). If irrigation is necessary, water early in the day to allow plants to dry off before nightfall. Benlate does not control Phytophthora. (See note 4) Benlate will only improve Botrytis control where the fungus is not resistant to Benlate.
	Slugs	Metaldehyde bait		Distribute along edge of rows but not on strawberry plants. Keep domestic animals and birds from treated areas. Read label re: poisoning. Very poisonous to dogs.

RENOVATION Immediately after harvest	Root weevils when root weevil damage is evident in the field	chlordane	3.25 kg (active)	Repeat in three weeks. Do not apply chlordane again to the same field for at least four years.

[1] Minimum period before reentry is 24 hours.
[2] Minimum period before reentry is 48 hours.

OTHER PESTS:

1. **Two-spotted mite:** Spray to cover undersides of leaves thoroughly at first sign of this mite and repeat application at 7-day intervals. Use one of Kelthane (35% dicofol AP) 2.75 kg (2 days); [1]Phosdrin (mevinphos) 550 mL (1 day); or ethion 25% WP 2.25 kg (8 days); Plictran 50 W 2.25 kg (7 days) per hectare.
2. **Leafhoppers:** When leafhoppers first appear, spray with [1]Phosdrin (mevinphos) 550 mL (1 day) per hectare.
3. **Strawberry root weevil:** This is not the same insect as the strawberry weevil that clips the blossoms in the spring. Since the adult cannot fly, isolation of the new strawberry planting from older planting should provide protection. Chlordane as recommended for white grub and wireworm should provide control.
4. **Leathery rot (Phytophthora):** This disease may be a problem in fields where Benlate or Easout are the only fungicides used. Use captan.
5. **Powdery Mildew:** Renovate old plantings immediately after harvest. If a problem in new plantings, apply Benlate 50% WP at 1.1 to 1.75 kg/ha.
6. **Cyclamen mite:** Spray with Thiodan (50% endosulfan WP) 2.2 kg (7 days) in 1000 L of water, and apply at 5000 to 8000 L of spray per hectare. Plow under old plantings. DO NOT plant new plantings adjacent to older plantings.

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[1] Minimum period for reentry is 24 hours.

GUIDELINES FOR SPRAYING STRAWBERRIES

To find the nozzle size for a boom sprayer do the following:

1. Divide the number of square metres per hectare by the swath width.

$$\frac{10{,}000\ \text{(square metres)}}{\text{width (metres)}} = \begin{array}{c}\text{travel distance}\\ \text{(metres per hectare)}\end{array}$$

2. $$\frac{\begin{array}{c}\text{Travel distance}\\ \text{(metres per hectare)}\end{array}}{\begin{array}{c}\text{Travel speed}\\ \text{(metres per minute)}\end{array}} = \begin{array}{c}\text{spraying time}\\ \text{(minutes per hectare)}\end{array}$$

3. $$\frac{\text{Litres per hectare}}{\text{Minutes per hectare}} = \begin{array}{c}\text{Litres per minute}\\ \text{(for all nozzles)}\end{array}$$

4. $$\frac{\text{Litres per minute}}{\text{Number of nozzles}} = \text{Litres per minute per nozzle}$$

5. From manufacturers' charts (see pages 41-47, publication 373, Orchard Sprayers), choose a nozzle to give this output at the desired pressure. Further guidance is found in the section on "Strawberries."

Results from a recent sprayer assessment show that several factors contribute to poor control of botrytis rot of blossoms and berries.

1. Foliage that is very tall and dense keeps the humidity high and promotes rot.
2. Very wide rows and narrow spaces cause poor aeration and slow drying.
3. Booms having all nozzles above the crop give poor penetration and light deposits on lower surfaces of leaves and on calyxes of blossoms.
4. Air-blasts row-crop sprayers spray well only the first three rows. Sides away from the sprayer get poorer coverage.
5. Conjet air-shear sprayer with drive nozzles penetrates well, especially when drop arms are used.
6. Drop arms on boom sprayers improve coverage greatly.
7. Speeds greater than 3 km/h with boom sprayers give poorer coverage.
8. For fruit rot control, good timing is essential. Spray deposits must be renewed after rains, etc.
9. Use screens in nozzles that are fine enough to remove particles that would block nozzle chosen.

WEED CONTROL IN STRAWBERRIES (Also see OMAF Publication 75, Guide to Chemical Weed Control.)

WEEDS	MATERIALS AND RATES	NOTES
1. **2 to 6 weeks after planting** Germinating weeds	Dacthal 75 WP (chlorthal dimethyl) 13 kg (product) per hectare	Apply after a clean cultivation or before weeds emerge. Do not apply more than three applications during the first year.

WEED CONTROL IN STRAWBERRIES (Also see OMAF Publication 75, Guide to Chemical Weed Control.) (Continued)

WEEDS	MATERIALS AND RATES	NOTES (Rates are per hectare actually treated unless otherwise stated)
	Enide 50 WP (diphenamid) 10 to 13.5 kg (product) per hectare	Apply as above. Do not apply more than two applications during the first year. Weed control may be improved by shallow cultivation following application or by irrigating (12 to 25 mm water) before or immediately after treatment.
Broadleaf annual seedlings	Tenoran 50 WP (chloroxuron) 8.75 to 11 kg (product) in at least 300 L water per hectare	Apply early postemergent before weeds are 3 to 5 cm high. Do not use more than three applications during the first year.
Broadleaf annual and perennial weeds	2,4-D Amine 550 g acid per hectare in 100 to 200 L water	Use low pressure and a coarse spray to avoid damage through drift to susceptible crops. Do not use when early runners are rooting in June to early August or when the crop is in bud or bloom.
2. **4 to 6 weeks after planting** Germinating and seedling weeds	Sinbar 80 WP (terbacil) 275 to 550 g (product) in at least 300 L water per hectare	Preemergence or early postemergence to weeds when mother plants are well established but before runners start to root. Controls many germinating and small broadleaf weeds and grasses. Use lower rate on sandy soil low in organic matter or on the sensitive varieties Earlidawn, Midway, Micmac, and Bounty. Weak or diseased plants may be injured.
3. **Late summer and fall** (Planting and harvesting years) Germinating weeds	Dacthal 75 WP (chlorthal dimethyl) 8.75 to 12.5 kg (product) per hectare	Apply preemergent to weeds. Soil moisture required to ensure weed seed germination.
Common chickweed and small broad-leaved weeds	Tenoran 50 WP (chloroxuron) 8.75 to 11 kg (product) per hectare in 300 to 500 L water	Apply early postemergent to both common chickweed and other broad-leaved weeds.
Germinating and seedling weeds	Sinbar 80 WP (terbacil) 180 to 275 g (product) in at least 300 L water per hectare	Preemergence or early postemergence to weeds to provide control until late fall.
4. **Late fall** (planting and harvesting years) wheat winter annuals and early germinating spring weeds	Sinbar 80 WP (terbacil) 700 to 850 g (product) in at least 300 L water per hectare	Apply just before mulching on healthy vigorous plants. Use the lower rate on sandy soils with low organic matter or on the sensitive varieties Earlidawn, Midway, Micmac and Bounty, also where terbacil will be applied next spring.
5. **Early spring** (harvesting years) Seedling weeds	Tenoran 50 WP (chloroxuron) 8.75 to 11 kg (product) per hectare	Early postemergence to weeds or to growing chickweed. Do not apply in the 60 days before first pick.
Germinating weeds	Dacthal 75 WP (chlorthal dimethyl) 13 kg (product) per hectare	Apply preemergence to weeds or after a clean cultivation.
Germinating and seedling weeds	Sinbar 80 WP (terbacil) 275 to 350 g (product) in at least 300 L water per hectare	Apply immediately after mulch is removed. Strawberry plants that have made weak yellow growth under the mulch may be severely injured.

6. **After harvest (renovation)** Germinating weeds	Dacthal 75 WP (chlorthal dimethyl) 11 to 17.5 kg (product) per hectare	Apply immediately after renovation preemergent to weeds. Soil moisture required to ensure weed seed germination.
	Sinbar 80 WP (terbacil) 700 to 850 g (product) in at least 300 L water per hectare	Apply after rototilling if rows are narrowed by rototilling during after-harvest renovation. Do not apply 2,4-D and terbacil at the same time. Separate applications by one to two weeks.
Broad-leaved weeds	Tenoran 50 WP (chloroxuron) 8.75 to 11 kg (product) per hectare	Apply early postemergent to weeds.
	2,4-D Amine 1.1 kg acid per hectare	For the control of dandelions, etc. Delay mowing a few days after application. Do not apply 2,4-D between mid-August and fall dormancy as it may reduce flower bud formation. Veestar is more sensitive to 2,4-D than Redcoat.

CAUTION: Sinbar (terbacil) may leave soil residues which can be harmful to some crops for up to two years.

CURRANTS AND GOOSEBERRIES

For dilute spraying use 1800 L per hectare.
Amount per 450 L is one quarter rate per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 450 LITRES	NOTES
Before buds break	Scale insects	Superior oil	9.0 L	
As buds are bursting	Currant insects	Malathion 25% WP	700 g	Spray when temperature is above 15°C.
Just before blossoms open	Leafspot	Use one of: (1) ferbam 76% WP (2) Phaltan 50% WP	 1.0 kg 1.20 kg	 Currants only. Currants and Gooseberries.
	Powdery mildew	Sulphur 90-95% WP	6.75 kg	Gooseberries only.
	Currant sawfly	(1) rotenone 5% WP (2) diazinon 50% WP	2 kg 500 g	Repeat as necessary.
Postbloom as soon as bloom is complete	Leafspot	Add one of fungicides listed above.		
	Powdery mildew	Same as for mildew above.		Repeat weekly if weather is wet.
	Currant Fruit Fly (maggot)	Use one of: (1) Methoxychlor 50% WP (2) Malathion 25% WP	 1.2 kg 700 g	
10 days after Postbloom spray	Leafspot	Same as for Leafspots above.		Do not use ferbam within 14 days of harvest or Phaltan within 7 days. Spray Red and White Currants immediately after fruit is picked.

CURRANTS AND GOOSEBERRIES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 450 LITRES	NOTES
	Currant Fruit Fly (maggot)	Same as for Fruit Fly above.		Do not use methoxychlor within 14 days of harvest or malathion within three days.
Postharvest	Leafspots	Same as for Leafspots above.		

POLLINATION:
Currants and gooseberries are self-fertile, but insects assist in pollen transfer. Honeybees have been shown to increase crop yield.

Weed Control in Currants and Gooseberries

WEEDS	MATERIALS AND RATES PER HECTARE	NOTES (**Rates are per hectare actually treated.**)
Emerged weeds and grasses	Gramoxone (paraquat) 5.5 L (product) in 1000 L water per hectare or 55 mL in 10 L of water	Spray to wet weed foliage. Use as a directed spray when weeds are less than 15 cm high. Avoid wetting the leaves and green bark of the bushes. Quack grass may require two or three applications during the season for control. Best results are obtained by spraying on a dull cloudy day or in the evening.

SOIL MANAGEMENT
– FRUIT CROPS

General Considerations

Leaf analysis is the best method of determining nutrient needs in established fruit trees and grapes. Prior to planting the orchard, vineyard or strawberry plantings soil tests are recommended. Soil pH (acidity) should also be checked, particularly in the parts of the orchard where nitrogen fertilizer is applied. Leaf analysis service and soil testing services are offered by the Ontario Ministry of Agriculture and Food with information supplied by your local Horticultural Crop Advisor.

Leaf analysis most accurately reflects the uptake of nutrients by the trees or vines. Nutrient uptake is affected by all orchard conditions including nutrient and moisture supply. Consequently, each year the actual amounts present will be slightly higher or lower depending upon the season. In order to obtain optimum growth and fruit quality adequate levels of the nutrients must be present in the leaves and the relative amounts must be balanced. For example, with McIntosh optimum fruit storage quality is obtained when the amount of leaf nitrogen is 2.1% and the ratio of nitrogen relative to potassium is 1.25. A higher ratio indicates excessive nitrogen whereas a lower ratio may be reflected in poor terminal growth, light foliage, reduced fruit size and crop.

Even with optimum levels of nitrogen or potassium poor growth can be attributed to low levels of magnesium, boron, zinc or other micronutrients which will be reflected in the leaf analyses. For leaf analyses to be most effective, the same trees should be sampled each year and yearly adjustments made to the fertilizer program on the basis of leaf analyses, growth, fruit size, color and storage quality, etc. Some growers sample every third year to monitor the effectiveness of their fertilizer program. (Further information is available on the current Factsheet on Leaf Analysis.)

Nitrogen

Most bearing orchards require annual applications of nitrogen fertilizer. However, certain precautions must be observed. Fruit trees need ample amounts in the spring to start vigorous growth. If too much nitrogen is applied, or if it is applied too late in the season, fruit color and quality may be poor. While this is particularly serious for apples that are kept in long term storage, it is also true of other fruits, including peaches. Excessive nitrogen, therefore, must be avoided late in the season. Nitrogen should be applied in early April to allow proper utilization. Urea has been successfully applied in late fall, but more nitrogen may be required than in the spring.

The use of cover crops in cultivated orchards will help to lower the nitrogen level in the latter part of the season. Cover crops such as Italian ryegrass, sown about July 1 in orchards or August 1 in vineyards, will take up much of the available nitrogen in the soil and in this way have a desirable effect in checking tree growth.

In herbicide-treated strips under trees, weed growth late in the season will take up extra nitrogen and assist in hardening off trees and improve fruit quality. Mouse control must be part of the management system.

Table 8 indicates the percentage of nitrogen found in mid-shoot leaves collected from bearing fruit trees after the terminal bud has formed in mid-July or in grape petioles collected in September.

TABLE 8. NITROGEN LEVELS IN MID-SHOOT LEAVES OF FRUIT TREES TAKEN THE LAST 2 WEEKS OF JULY AND IN GRAPE PETIOLES TAKEN IN SEPTEMBER.

	Percentage Nitrogen		
Tissue Samples	**Low Less than**	**Optimum Range**	**High Above**
Apple Leaves			
a. McIntosh	1.8	2.0-2.3	2.5
b. Delicious, Paulared, Tydemans, Scotia, Mutsu	2.0	2.2-2.6	2.7
c. Spy, Russet, Empire, Macspur	1.9	2.1-2.5	2.6
Peach Leaves			
a. Most varieties	3.2	3.4-4.0	4.2
b. Sunhaven, Babygold 7, Candor, Velvet, Harbelle	3.3	3.5-4.2	4.3
c. Redskin, Harbinger, Harbrite, Vivid	3.1	3.3-4.0	4.1
Pear Leaves			
a. Most varieties	1.9	2.1-2.5	2.6
b. Bosc and Clapp	2.0	2.2-2.6	2.7
c. Flemish Beauty	2.1	2.3-2.7	2.8
Montmorency Cherry Leaves	2.0	2.2-2.8	2.9
Grape Petiole Analysis			
a. Most varieties	0.6	0.6-1.2	1.2
b. De Chaunac, Foch, Baco Noir, Verdelet	0.7	0.7-1.3	1.3
c. President, Fredonia, Niagara, Catawba	0.5	0.5-1.0	1.1

Note:

1. For non-bearing trees the nitrogen levels should be 0.2% higher.
2. For apples on M9 and M26 rootstocks nitrogen levels should be 0.2% higher.

Nitrogen Rates

The best guide to rates, as already suggested, is tree growth and behavior, fruit yield, color and quality, variety, type of management and nutrient balance in your soil. However, as a general rule of thumb for cultivated orchards, the following rates could be considered normal. Apply for each year of the tree's age, 20 g of nitrogen (60 g ammonium nitrate or 45 g urea or 130 g calcium nitrate). Thus a 20-year-old tree in a cultivated orchard would require 400 g nitrogen (1.2 kg ammonium nitrate or 0.9 kg urea or 2.6 kg calcium nitrate). Use the most economical source of nitrogen based on cost per unit of nitrogen.

For unmulched sod orchards, immediately following sod establishment, the rates should be doubled. If the orchard is mulched, the need for nitrogen will vary depending on the kind of sod and the mulch being used. Between 20 and 30 g nitrogen per year of a tree's age should be applied.

Suggested maximum rates of nitrogen application in cases of severe deficiency are 1.5 kg nitrogen per tree or equivalent for mature apple or sweet cherry trees in sod, and 0.75 kg nitrogen per tree in cultivation. For cultivated peach and sour cherry trees a maximum of 0.75 kg nitrogen per tree is suggested. Pear and plum orchards in sod should not receive more than 1.25 kg nitrogen per tree.

Varieties differ in their nitrogen requirements. For example, a variety grown for processing could receive more nitrogen than one for fresh market. If fruit size tends to be small, more nitrogen may be needed. Rootstock, spacing and pruning also have an influence. When the tree canopy has covered the space available, nitrogen fertilizer requirements will level out and will not increase indefinitely with tree age. Again, leaf analysis is the most reliable guide.

A spring application of 35 kg nitrogen/ha broadcast on the sod, in addition to the application required by the trees, will encourage sod growth.

Nitrogen Placement

In cultivated orchards nitrogen should be broadcast under the tree canopy. In sod orchards the nitrogen should be placed in a band under the drip line or in the herbicide strip to be more effective. On young trees the fertilizer should be broadcast at least 15 cm from the trunk, under the spread of the branches.

Nitrogen Equivalent Table

Different fertilizer materials supply different amounts of nitrogen. These are shown in Table 9. For example, 44 kg of ammonium nitrate is equivalent to 97 kg calcium nitrate, or 33 kg urea.

TABLE 9. AMOUNT OF NITROGEN FERTILIZERS REQUIRED TO SUPPLY SPECIFIC AMOUNTS OF NITROGEN

NITROGEN (N) kg	Ammonium Nitrate (34% N) kg	Urea (45% N) kg	Potassium Nitrate (13% N) kg	Calcium Nitrate (15.5% N) kg
5.0	15	11	38	32
10.0	29	22	76	64
15.0	44	33	115	97
20.0	59	44	154	130
30.0	88	67	230	194
40.0	118	89	308	259

In deciding what nitrogen fertilizer to use, calculate the cost per unit of nitrogen. Under most conditions, the fertilizer which costs least per unit of actual nitrogen should be used. This may not be the cheapest per tonne of fertilizer.

Foliar applications of urea (45% nitrogen) have been used successfully on apples and strawberries, when weather or crop conditions resulted in a need for additional nitrogen at a critical time. They are not generally recommended. Late application on apples may adversely affect quality. A foliar grade of urea should be used for foliar applications. High biuret content in urea may result in foliage injury. On apples, use no more than 6 kg product/1000 L and apply at least 2000 L/ha starting with the first cover spray, and spacing the sprays about 10 days apart. Do not apply more than three times. On low-nitrogen, fruiting strawberry plantings, apply at the same rate as for apples, at weekly intervals until the harvest is near completion.

Do not rely on urea sprays to completely substitute for soil applications if nitrogen is required. Under some conditions nitrogen starvation of woody tissue can occur leading to poor fruit set and fruit development.

Potassium

Potassium is an important nutrient for tree fruits and grapes. It is frequently required in Ontario orchards and vineyards.

The concentration of potassium and magnesium found in leaf and petiole samples given in Table 10 are guidelines to be used

TABLE 10 POTASSIUM (K) AND MAGNESIUM (MG) LEVELS IN MID SHOOT LEAVES OF FRUIT TREES TAKEN THE LAST 2 WEEKS OF JULY AND IN GRAPE PETIOLES TAKEN IN SEPTEMBER

	% Potassium			% Magnesium		
	Low	Optimum	High	Low	Optimum	High
	Less Than		Above	Less Than		Above
Apple leaves	1.1	1.2-1.9	2.0	0.20	0.25-0.34	0.35
Peach leaves	1.8	1.9-3.0	3.0	0.35	0.40-0.79	0.80
Pear leaves	1.0	1.0-1.6	1.7	0.20	0.25-0.50	0.50
Montmorency Cherry leaves	1.2	1.3-2.0	2.1	0.30	0.35-0.85	0.85
Grape Petioles						
a. Most varieties	0.9	1.0-2.0	2.0	0.50	0.50-2.0	2.0
b. Agawam, Foch, Delaware, Dutchess, Baco Noir, Villard Noir, Riesling	1.1	1.2-2.2	2.2	0.50	0.50-2.0	2.0
c. De Chaunac, P. Chardonnay	1.2	1.3-2.3	2.3	0.50	0.50-2.0	2.0
d. Concord, Elvira, President, Fredonia, Catawba, Veeport, Patricia, Vincent, Ventura	0.7	0.8-1.8	1.8	0.50	0.50-2.0	2.0

in determining the nutrient status of orchards and vineyards.

Most orchardists prefer applying potassium separately as muriate of potash in a band around the drip line of the tree in sod orchards. In sandy soils this band should be at least 60 cm wide. In cultivated orchards it should be broadcast prior to cultivation in the spring. Early spring application is preferred in sod and clean cultivated orchards. No more than 3 kg of K2O (5 kg muriate of potash) should be applied per mature tree in a year.

CAUTION: On young trees, especially on sandy soils, trunk and root damage may occur if the fertilizer is applied in a narrow band or too close to the trunk.

Magnesium

Magnesium deficiency is becoming more evident in apple orchards, particularly in eastern Ontario or when high rates of potash are used. Magnesium deficiency of grapes is also occurring more frequently. Foliar application of magnesium sulfate (epsom salts) is effective in controlling this deficiency on high lime soils.

At least 3.8 kg magnesium/ha (40 kg magnesium sulfate) should be applied at each time of application. For dilute application, use 1.9 kg magnesium/1000 L with at least 2000 L/ha. Do not exceed 3.8 kg magnesium/1000 L. Fruit or foliage injury is possible from a mixture of pesticides with magnesium sulfate. Mixtures with Cyprex, Captan, Benlate and Polyram, Imidan and Sevin have been applied to apples with no foliage or fruit injury. However, growers would be wise to try mixtures on a few trees before spraying a complete orchard.

Magnesium sprays should be applied, starting around the calyx period for apples and late July for grapes, continuing on a weekly schedule until the three sprays are applied.

Rates of magnesium chelate are being evaluated. It reportedly can be safely mixed with pesticides.

Soil applications of magnesium in combination with foliar application may give a longer-lasting effect. Sulfate of potash-magnesia may be applied when both potash and magnesium are required. Dolomitic limestone should be used to supply magnesium on acid soils.

Phosphorus

Phosphorus is not required in large amounts by fruit trees but sod and cover crops require both phosphorus and potassium which can be broadcast to the orchard floor. Soil tests are required to determine the P requirement of cover crops.

Calcium

Spray applications of calcium are effective in reducing bitter-pit in Northern Spy and other apple varieties susceptible to this disorder. Calcium chloride supplying 1.8 kg calcium/1000 L (5 kg calcium chloride) or calcium nitrate supplying 1.4 kg Ca/1000 L (7 kg calcium nitrate) can be used starting in mid-July and at two-week intervals for at least three sprays. At least 2000 L/ha should be applied at each application. DO NOT CONCENTRATE CALCIUM SPRAY. The effectiveness and recommended rates of calcium chelates are being studied. The more calcium that can be applied the better the control.

Calcium has also been related to gummosis of Italian prune and bunch stem necrosis of certain grape varieties. Spray application of calcium has reduced the extent of these disorders.

Lime

In recent years a trend to lower soil pH has been noted particularly in tree rows. When pH drops below 5.0, lime should be applied. This will raise the soil pH (reduce the acidity) and also supply calcium. Dolomite lime (high in magnesium) should be used on soils low in magnesium. Rates of application will vary with soil type and initial pH. The amount of lime required should be evaluated by soil test.

Lime will be more effective if it is incorporated into the soil. Incorporation prior to orchard planting is the preferred method of adjusting the pH.

Micronutrients

Deficiencies of micronutrients or trace elements are not widespread in Ontario fruit plantings. Boron deficiency is the most common. Deficiencies of zinc, manganese and iron may show up occasionally, particularly in alkaline soils.

The range between enough and too much is very small for micronutrients. Many of them are more harmful in excess than in deficiency. For this reason, micronutrients should not be applied to fruit crops except when deficiency is shown by leaf analysis, visible symptoms, or on the advice of trained technical persons.

Boron

Boron deficiency occurs mainly on alkaline soils or on sandy knolls. Apples are the most sensitive of the fruit crops to boron deficiency. Symptoms include internal breakdown of the fruit, highly colored fruit that drops prematurely. Soluble boron fertilizers such as 'solubor' should be applied at rates supplying 0.2 kg boron/1000 L (1 kg solubor/1000 L) twice starting in early June. At least 2000 L/ha should be sprayed if a proven deficiency of boron exists. Boron excess may result in a yellowing of leaf edges and midrib, reduced yields, and a shortened storage life of the fruit.

Manganese

Manganese deficiency occurs occasionally in fruit growing areas of Ontario. Its occurence is closely related to weather conditions particularly rainfall and soil moisture, as well as soil pH. It is most prevalent in wet seasons or with high soil pH (alkaline conditions).

In mild cases of deficiency, there is a yellowing of the interveinal leaf areas of young leaves near the shoot-tip. Normally, this is not serious. Fruit size, yield, and quality appear to be unaffected. If the condition is severe, spray application of manganese sulfate at the rate of 1.3 kg Mn/1000 L (5 kg product) at 2000 L/ha may be used as a corrective measure. Manganese chelates are also effective in correcting manganese deficiency at the rate of 0.25 kg Mn/ha (5 L/ha of 5% product).

On Red Delicious, manganese toxicity can occur on light textured acid soils. The symptoms known as "measles" are raised pimples on the bark underlain by dark brown spots. Other symptoms that may be observed are leaf chlorosis, tip dieback, early leaf abscission, reduced flower bud development and shoot growth. Correction is sometimes possible by addition of lime to raise the pH provided it can be worked into the soil. Soil sampling and addition of lime if pH is low is recommended prior to orchard planting of Delicious and other varieties.

Iron

Iron deficiency, commonly termed lime-induced chlorosis, is not widespread in Ontario orchards. Occasionally, one or two trees in an orchard may exhibit iron-deficiency symptoms. On investigation, it is often found that these trees are located near the site of previous lime or building plaster storage, etc., where the soil pH is abnormally high.

Iron deficiency causes interveinal chlorosis of new leaves. As the condition becomes more severe, the whole leaf becomes pale yellow. Quite often only one side or one branch of the tree is affected.

Iron Chelates have made correction of iron deficiency relatively easy. These materials can be applied safely as foliar sprays at the rate of 0.25 kg/Fe/ha (5 L/ha of 5% product).

Zinc

Zinc deficiency has been identified in some apple orchards in eastern Ontario. The symptoms of this deficiency are short internodes, small narrow leaves, interveinal chlorosis with shoot and branch dieback. In advanced stages, small, narrow terminal leaves are arranged in whorls or "rosettes", giving rise to the typical "rosette" and "little leaf" descriptions for zinc deficiency. Except in severe cases, only a few shoots on an otherwise normal tree will show symptoms. Zinc sulphate supplying 3.6 kg zinc/1000 L as a dormant spray in early spring is effective.

Dilute sprays in June of zinc sulphate or chelate containing 0.35 kg Zn/ha (1 kg 36% ZnSO4 or 5 L 6.5% * Zn chelate) are effective in correcting zinc deficiency on fruit trees.

WARNING: DO NOT
CONCENTRATE NUTRIENT
SPRAYS.

**Use chelates recommended for foliar sprays*

Organic Amendments

Many types of organic amendments including manures, hay and straw can be successfully used in orchards or vineyards. The main reason for using these materials is for their organic matter content. Soil organic matter plays an important role in maintaining good soil structure, aeration and water penetration.

Organic matter broken down by cultivation should be replaced by the addition of organic amendments. In vigorous sod orchards, the use of organic amendments is not usually necessary. Manure also contains nutrients and fertilizer rate should be reduced (Table II) when it is applied.

The disadvantage of adding manure to orchards is that the nitrogen is released over a prolonged period of time. The slow release means that the perennial crops continue to be supplied with nitrogen during the year which can result in poor fruit color, excessive terminal growth and delayed hardening of the woody tissue making the plants more susceptible to winter injury. Manure, if applied, should be used in late fall or early spring.

Manure contains considerable amounts of nitrogen and potassium, and smaller amounts of phosphorus. It is extremely variable in nutrient and dry matter content. One factor contributing to this variability is the source of manure. Poultry manure is higher in nitrogen than other sources and must be used with caution. No more than 7 t/ha of poultry manure should be applied per year. This would be approximately equivalent in nutrient value to 20 cubic metres of liquid poultry manure, 40 tonnes of cattle manure or 100 cubic metres of liquid cattle manure. Hog manure is slightly higher in nitrogen than cattle manure. No more than 35 tonnes of solid hog manure or 65 cubic metres of liquid hog manure should be applied per hectare.

Straw or spoiled hay are other excellent sources of organic matter. As manure becomes more difficult to obtain and more costly, straw or hay will be more widely used in orchards. Seven tonnes of straw or hay per hectare will supply approximately the same amount of dry matter as 22 t of manure/ha. The nutrient content of these materials varies. Legume hay contains approximately three times as much nitrogen as non-legume hay or straw. If non-legume hay or straw is used, apply 28 kgN/ha in the fall and another 28 kgN/ha in the spring to facilitate breakdown and avoid nitrogen starvation.

One of the best ways of supplying organic matter to orchards is to grow it in the orchard. If the orchard is cultivated, cultivation should be stopped by July 1 and a cover crop such as Italian ryegrass seeded at the rate of 13 to 17 kg/ha. Use soil tests to determine optimum fertilizer rates or fertilize with 10-20-20 at 100 kg/ha before seeding to promote growth and organic matter production.

If permanent grass is desired, tall fescue or creeping red fescue make excellent sods and also offer some suppression of nematodes. To aid germination, they should be seeded as shallow as possible at the rate of 20 to 22 kg/ha. The soil needs to be well prepared and fertilized according to soil test results or with 10-20-20 at 100 kg/ha before seeding. Sod mixtures containing grasses and legumes can also be used, but inclusion of legumes results in some loss of control of nitrogen levels.

Recommendations in Establishing a New Orchard

Before setting a new orchard, soil tests should be made to determine the fertilizer and lime requirements of the proposed site. Preplanting applications should be worked into the soil as deeply as possible before the trees are set. Unless the soil is particularly nitrogen-deficient, no nitrogen fertilizer should be applied in the planting year. On coarse-textured, infertile soils, the use of a starter solution at planting time may give the trees a needed boost.

High nitrogen levels can result in excessive top growth and incomplete tree hardening. The practice of putting manure around newly planted trees is not recommended. If manure is used, it should be applied broadcast and worked into the soil

TABLE 11. REDUCTIONS IN FERTILIZER APPLICATION WHERE MANURE IS APPLIED*

Class of Livestock	Nitrogen (kg/ha)			Phosphate P_2O_5Kg/ha)	Potash K_2O(kg/ha)
	F.& W.**	Spr.**	Spr.C**		
Liquid Manure at 10 cubic metres/hectare					
(One cubic metre = 220 imp. gal; one cubic metre/ha = 90 gal/ac)					
Cattle, Mixed Livestock	5	10	12	4	16
Swine	8	15	19	7	14
Poultry	23	46	58	22	26
Solid manure at 10 tonnes/hectare					
(66 bu. or 2.40 cubic metres of solid manure = 1 metric tonne approximately. Ten t/ha = 4.5 ton/ac.)					
Cattle, Mixed Livestock	12	24	30	10	44
Swine	15	30	38	20	26
Poultry	70	140	175	75	96

** These adjustments are based on slightly below average quality manure.*

***F. & W. denotes fall and winter applied manure; Spr. denotes spring applied and not covered immediately, including surface application after seeding; Spr.C. denotes spring applied manure injected or otherwise covered within one day of application.*

before planting. The use of green-manure crops to check late-season growth is strongly recommended in new plantings.

However, grass and weeds should not be allowed to grow around young trees in the early part of the season. Trees should be encouraged to make adequate growth the first few years in the orchard by the elimination of the competition for moisture and nutrients during the early part of the growing season. Irrigation may be required if it is dry after planting. Trees that are stunted early in their life may never overcome this setback.

It is extremely important to start trees in a weed-free area and keep it clean in the early part of each growing season. A 2 m herbicide strip should be adequate. Even in mature orchards, grass under the spread of the tree branches should be controlled by the use of a herbicide or by a mulch. The mulch offers added benefits of higher soil temperatures in winter and lower soil temperatures in summer. It also conserves soil moisture and slowly adds essential nutrients as it decomposes. Extra care in mouse control is necessary with mulch.

Apples

Pruning programs should be considered in deciding nitrogen rates for apples. If pruning is to be severe, nitrogen rates can be cut back or eliminated for a year. On the other hand, light pruning may require higher nitrogen rates to maintain tree vigor and production.

Trees on dwarfing rootstocks generally require more nitrogen per hectare (not per tree) than trees on more vigorous stocks. However, care must be taken with dwarfing root-stocks to avoid too large a crop load and loss of vigor. In fertilizing closely planted trees on dwarfing stocks the percentage of the area is a better guide to fertilizer requirements than tree age. No more than 150 kg nitrogen should be applied per hectare. To assess factors that affect fertilizer requirements, leaf analysis offers the best guide.

Tender Fruits

Most peach, tart cherry and plum orchards are grown with cultivation and a cover crop although they can be successfully grown in sod. Pears and sweet cherries are more frequently grown in sod. Fertilizer requirements, particularly nitrogen requirements, will depend on type of soil management as previously outlined.

Peach canker is more serious when nitrogen levels are excessive. Nitrogen rates must be kept moderate in peach orchards for this reason alone. Winter injury is more serious if too much nitrogen is supplied especially with insufficient potassium fertilizer. Cultivation should be stopped early (by early July) in peach orchards to avoid late nitrogen release and more serious winter injury and canker problems.

Fire blight is aggravated by excessive rates of nitrogen in Bartlett pear orchards. However, nitrogen levels should be at a sufficiently high level to produce fruit of adequate size. Balancing nitrogen with adequate potassium may help avoid fire blight.

Grapes

The main limitation of most soils used for grapes in the Niagara Peninsula is their fine texture and poor drainage. Most clay loam soils used for grapes need organic matter. Every practical means of increasing the organic-matter level by the use of manure, cover crops, etc., should be followed. Cattle manure is much preferred to lower rates of poultry or hog manure because larger amounts of organic matter can be supplied in this way without the risks of excessive nitrogen. (See discussion of Organic Amendments).

Cover crops such as rye grass should be sown about August 1. Earlier seeding can reduce yields of grapes by increased competition for moisture and nutrients.

In some vineyards, while the soils themselves contain large amounts of potassium, not enough is released to the vines. The addition of potash fertilizer is desirable in most vineyards. Applying potash once every second year is more effective than annual application of smaller amounts under these soil conditions. On the better-drained, coarser textured soils, nitrogen fertilizers give both vine and yield response.

Most grapes grown on coarse sands in southwestern Ontario

(Cont'd on page 65)

TABLE 12. PHOSPHORUS AND POTASSIUM REQUIREMENTS FOR BLUEBERRIES, STRAWBERRIES, RASPBERRIES, CURRANTS, GOOSEBERRIES AND NURSERY STOCK.

		Phosphorus				**Potassium**
		Phosphate Required kg P_2O_5/ha				
Soil test (ppm P)	**Rating**	**New Plantings**	**Established Plantings**	**Soil Test (ppm K)**	**Rating**	**Potash Required kg K_2O/ha**
0-3		140	100	11-15		130
4-5		130	90	16-30		120
6-7		120	80	31-45		110
8-9	Low	110	70	46-60	Low	100
10-12		100	70	61-80		90
13-15		90	60	81-100		80
16-20		70	50	101-120		70
21-25		60	40	121-150		60
26-30	Medium	50	30	151-180	Medium	40
31-40		40	20			0
Above 40	High	0	0	Above 180	High	0

TABLE 13. GENERAL FERTILIZER RECOMMENDATIONS FOR FRUIT CROPS

To be used only when leaf analysis or soil test is not available.

	Manure, Hay, Straw (see footnote)	**Fertilizers General rates** Adjust on the basis of leaf analyses	**Soil Management**
Orchards, Cultivated	7 t/ha of hay or straw[1] annually in the fall with 30 kgN/ha. Add another 30 kgN/ha in the spring. OR 22 t/ha of manure[2] annually in the fall or early spring.	In the spring, add nitrogen, the amount based on tree age (see Nitrogen page 58). Add 175 kg/ha of muriate of potash. OR 350 kg/ha (0-10-30 or equivalent) Apply 100 kg/ha (10-20-20 or equivalent) annually with the green-manure crop.	If cultivated, stop cultivation about July 1 and seed a green-manure crop such as Italian ryegrass at the rate of 13 to 17 kg/ha.
Orchard, Sod	No manure is needed after a vigorous sod is established and when a proper mulch is maintained. Mulch under trees with cover grown and cut in the orchard, and with additional old hay, straw, etc., as required.	175 kg/ha of muriate of potash OR 350 kg/ha (0-10-30 or equivalent) annually. In spring, add nitrogen, the amount based on tree age. (see Nitrogen page 38).	Mow as required.
Grapes	7 t/ha of hay or straw in the fall every other year, with 30 kgN/ha. Trash disk. Add another 30 kgN/ha in the spring OR 22 t/ha of manure[2] every other year.	100 kg/ha (10-20-20 or equivalent) annually with green-manure crop. On poorly drained clay and clay loams 450 kg/ha of muriate of potash. OR 550 kg/ha of muriate of potash every 2 years. On well-to imperfectly drained clay loams, loams, and sandy loams, 75 kg N/ha (225 kg/ha ammonium nitrate) every spring and 200 kg/ha of muriate of potash every year. OR 250 kg/ha of sulfate of potash every year.	Stop cultivation not later than August 1 and seed a green-manure crop such as Italian ryegrass at the rate of 13 to 17 kg/ha.
Strawberries	Year previous to planting: Plant a green-manure crop. And apply 45 t/ha manure[2] in the fall.	Year previous to planting: Apply 100 kg/ha 10-20-20 (or equivalent) with green-manure crop. Before planting: Apply 10-20-20 at 500 kg/ha (or equivalent). After planting: side-dress with 28 kgN/ha in late August in the first and subsequent years. On coarse-textured soils, an earlier side-dressing in the planting year may be advisable. The second and subsequent years after fruiting and before renovation, apply 500 kg/ha 10-10-10.	Year previous to planting: grow a green-manure crop.
Raspberries, Currants and Gooseberries	Before planting: Apply 45 t/ha manure[2] in the fall or spring. After planting: Apply 22 t/ha of manure annually in the fall or early spring or 7 t/ha hay or straw annually in the fall with 30 kgN/ha. Add another 30 kgN/ha in the spring.	In early spring, following fall planting, or prior to spring planting, and on established plantings: apply 500 kg/ha 10-20-20 or equivalent preferably made with sulfate of potash.	Each year after fruiting, seed a green-manure crop.

NOTES: 100 kg/ha = 90 lb/acre
1 tonne/ha = 0.45 tons/acre
N = Elemental Nitrogen

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[1] *If legume materials are used, the nitrogen supplement is unnecessary. Green-manure crops, or weed growth may supply sufficient organic matter, especially if well fertilized. However, most orchards will need some manure, hay or straw.*

[2] *See discussion of types of manure in text under Organic Amendments, page 62.*

Continued from page 63

would benefit from annual applications of potassium rather than applications every second year. A lower rate of potassium fertilizer is required to maintain adequate potassium levels on these soils. The chance of leaching loss is greater with this soil type. Magnesium deficiency is a more likely problem on the sandy loam soils. Petiole analysis is the best method of determining these nutrient needs.

Variety plays an important role in potassium requirements of grapes. Varieties such as Veeport, Delaware, Foch, De Chaunac and Dutchess require a higher potassium level than Concord or Niagara.

Small Fruits

Small fruit crops are shallow-rooted and, therefore, require soils well supplied with organic matter and high in fertility. Preparation of the soil before planting is particularly important. For strawberries, heavy manuring a year in advance of planting is suggested along with a well-fertilized, weed-smothering, green- manure crop.

If strawberries are to be interplanted between young trees, care must be taken not to stimulate the trees late in the season by late cultivation or too high a rate of nitrogen fertilizer. Long term tree performance should not be sacrificed for the short term inter crop.

When large amounts of straw are worked into the soil when the strawberry planting is to be discarded, extra nitrogen fertilizer (5 kgN) should be applied to ensure that the decomposing straw does not cause nitrogen deficiency in the trees.

Soil testing provides a good guide to phosphorus and potassium requirements of small fruits. Table 12 shows the amounts of phosphorus and potassium to apply at various soil test levels.

Blueberries

Successful growing of blueberries requires an acid soil with a pH level of 4.3 to 5.0 being optimum for plant growth. Sulfur and/or peat moss should be applied before planting to achieve this pH range.

The amount of fruiting wood is the best guide in determining the amount of nitrogen to apply. There should be enough strong, unbranched shoots each year to replace old canes that are removed by pruning. At pH above 5, use $(NH4)_2 SO_4$ to increase the acidity. If pH is below 5 use urea. Do not use the nitrate form of nitrogen on blueberries. Rates of nitrogen to be applied based on age of the plants are shown in Table 14.

A soil test is the most satisfactory method for predicting phosphate and potash requirements. Table 12 shows the amount of phosphorus and potassium to apply at various soil test levels.

If soil test information is not available apply rates of phosphate and potash recommended for low to medium soil tests in Table 12 in April. Sulphate of potash is preferred.

Magnesium deficiency is common with blueberry. Soil application of 19 kg/ha Mg (200 kg $MgSO_4$/ha) is effective in controlling this deficiency.

Iron deficiency can be corrected by proper control of soil pH and by application of iron chelate to the foliage and/or soil.

WEED CONTROL

The weed control recommendations in this publication are summaries of complete recommendations given in Ontario Ministry of Agriculture and Food Publication 75, 1983 Guide to Chemical Weed Control. For more complete information on chemicals, safety precautions, and calibration and care of sprayers, use Publication 75.

Many horticultural crops are damaged by some of our common herbicides. Sprayers that have been used for hormone-type (2, 4-D, etc.) chemicals SHOULD NOT BE USED for applying insecticides, fungicides or herbicides on susceptible horticultural crops.

It is difficult to control quack grass, bindweed, horsetail and similar perennial weeds in crops such as strawberries and raspberries which occupy the same area for a period of years. Perennial weeds of this type should be eradicated or brought under control before these crops are planted.

Use only enough pressure (approx. 200 kPa) to get uniform distribution of the herbicide mixture. Higher pressures produce smaller droplets which drift onto the crop leaves and young shoots causing injury.

Herbicide treatments are used in established orchards to suppress weeds and grass around fruit trees, and thereby reduce the danger of mouse injury during the winter. They can be applied to an area approximately 1 m in radius around the base of each tree or applied in a 1 to 1.5 m strip down the tree row, depending on the type of planting and the equipment used. Do not treat a strip wider than 1.5 m and do not use the strip treatment on rolling or hilly land where it might increase erosion. While older trunks may be fairly resistant to the chemicals, avoid excessive applications to them.

In vineyards the herbicides are applied to a strip under the vines. Applications may be made in the spring, fall, or both spring and fall but the recommended rates should not be exceeded in any one year.

Recommendations for strawberry plantings are based on a preventative program. This program is planting in land which is free of perennial weeds, and then using herbicides for the first part of the growing season which do not injure the strawberry plants and provide reasonable control of seedling weeds. The remainder of the program, especially after the first year, depends upon the use of terbacil. Use as low a rate of application as possible and in any case do not exceed the recommended rate.

THINNING OF TREE FRUITS

Thinning tends to encourage and maintain tree vigor and

TABLE 14. NITROGEN REQUIREMENT OF BLUEBERRIES

Plant Age	April 1-15 Mixed Fertilizer gN/plant	May 15 urea or $(NH_4)_2SO_4$ gN/plant	July 1 gN/plant
newly set	0	6	6
1 year	3	6	6
2 year	6	6-12	6-12
3 year	9	6-12	6-12
4 year	12	12-18	6-12
5 year	15	12-18	6-12
6 years or older	18	12-18	6-12

annual bearing, increase the yield of marketable fruit, improve size, color, and quality, reduce limb breakage, lessen winter injury, and minimize the handling and storage of low- grade and cull fruit. The earlier thinning can be done, the more effective it will be, especially with regard to annual bearing.

General Precautions

The results of chemical thinning are affected by (1) variety; (2) climatic conditions; (3) amount of fruit set; (4) tree vigor and health; (5) orchard management; (6) soil. Results vary from year to year. Insufficient thinning one year does not necessarily warrant increasing the concentration for following year.

The effectiveness of a chemical (except for dinitro) for thinning fruit is largely influenced by its rates of absorption by the leaves. Varieties differ in their ability to absorb these materials and thus they vary in their response to chemical thinning.

Note: The recommendations given herein should be used as a guide only. Each grower should proceed on a trial basis until he has found from experience the best methods for his particular set of conditions. It is strongly urged that checks be left and accurate records kept from year to year. After a few years of accumulated records of crop, tree vigor, weather, spray concentration, amount of spray, effectiveness of spray, etc., much of the guesswork can be removed from chemical thinning.

It is recommended that the thinning sprays be applied in the dilute form and as a separate spray, not as a supplement to a regular spray. The importance of thorough coverage is emphasized.

Apples

In Ontario naphthaleneacetic acid (NAA), naphthalene-acetamide (NAD) and Sevin can be used for the chemical thinning of apples.

NAD (naphthaleneacetamide) such as AMIDTHIN: This can be used at petal fall with no apparent injury to foliage or young growth. There is a definite advantage to early thinning, especially for early varieties such as Yellow Transparent, Quinte, Duchess, Melba, and Early McIntosh which have short growing seasons. It should not be applied on early varieties much later than petal fall. NAD is a milder and therefore safer material for thinning than NAA. Suggested concentrations vary from 50 to 100 ppm according to variety and orchard condition. NAD can be applied in 900 to 1100 L of water per hectare on standard trees. Under rapid drying conditions it may not thin heavy-setting varieties adequately. This may be overcome to some extent by applying in early morning or late evening. If the weather is calm, cloudy, warm and humid, NAD is the safer material to use.

NAA (naphthaleneacetic acid) such as NIAGARA-STIK, STAFAST, FRUITONE-N, BARTLETT-STIK: This material is usually applied 7 to 10 days after 95% of the petals have fallen (petal fall). Observation of bee activity and weather at that time, and subsequent fruit development permit a better estimate of thinning requirements. Under weather conditions favorable for rapid drying, NAA is more effective than NAD for thinning fall and winter varieties such as McIntosh and Delicious, but it can cause injury to the foliage and to the young shoots when applied within one week of complete petal fall. On the other hand, NAA may cause a reduction in fruit size with no thinning, or pre-mature ripening of early varieties when application is unduly delayed.

Suggested concentrations will vary from 3 to 20 ppm of NAA, depending on the variety. Varieties which may prove difficult to thin include Wealthy, Early McIntosh, Golden Delicious, Melba and Transparent. Delicious, Duchess, and Northern Spy are easily thinned while other varieties are intermediate. Directions for mixing in parts per million are given on the container and vary with the formulation. Apply as a dilute spray.

SEVIN (carbaryl): This insecticide may thin apples effectively when applied at 0.75 to 3.25 kg Sevin (active) per hectare of standard trees. Sevin causes more consistent thinning than NAA or NAD and absorption is less affected by weather. Where there is no conflict with an integrated insect-control program, Sevin is the preferred material for easy-to-thin varieties such as Delicious and Spy. Sevin is particularly dangerous to bees. Spray drift can reduce bee populations drastically. Sevin can be applied as a concentrate spray.

SEVIN PLUS NAA: Combinations of Sevin and NAA have given good results with several difficult-to-thin varieties including Early McIntosh and Wealthy. Try a constant rate of 0.75 kg Sevin (active) per 1000 L and varying rates of 3 to 15 ppm NAA. Apply as a dilute spray.

Bee Warning

When Sevin is used in fruit thinning, extensive bee kills can occur if the orchard cover carries a heavy bloom of dandelions or other weed blooms. To avoid such toxicity, keep the dandelions mowed and remove bees from the orchard prior to treatment. Do not spray when the wind will carry Sevin to adjacent weed areas. Advise local beekeepers of your spraying activity. Your local Agricultural Representative has a list of the beekeepers in your area.

Fruit Size as a Timing Index: "Days after petal fall" does not always provide a sufficiently accurate index for timing fruit-thinning sprays. Sensitivity to NAA depends on fruit development, which in turn depends on environmental conditions. Average fruit diameter reflects these yearly variations in growing conditions. Following are the fruit sizes which resulted in improved timing indexes for thinning three apple varieties in eastern Ontario. During a backward spring, fruits may require 12 to 13 days after petal fall to reach the NAA-sensitive stage, whereas during a warm spring, this stage may be reached within six days.

Variety	Average Diameter
McIntosh	**8.0 - 9.5 mm (approx. ⅜ in.)**
Delicious	**6.5 - 8.0 mm (approx. 5/16 in.)**
Spy	**10.0 - 11.0 mm (approx. 7/16 in.)**

Sampling Method: A total of 50 to 60 fruits of each variety should provide a good estimate of fruit development in a reasonably uniform orchard block. Take the two largest developing fruits from each of 25 to 30 randomly selected clusters, measure the greatest width of each and determine the sample average. Vernier calipers provide a simple means for taking measurements rapidly and accurately, although fruit-sizing rings are available.

Combinations of NAD and NAA: When experience has shown that naphthaleneacetamide alone has not given satisfactory thinning, it is suggested that growers combine 50 ppm NAD with 10 ppm NAA and apply four to five days after petal fall, as a dilute spray.

Defruiting immature apple trees to encourage proper development is highly desirable. Experimentation to date indicates NAA 15 ppm plus Sevin 1 kg (active) per hectare five days after petal fall as giving best results and NAA 35 ppm plus oil (10 L) as next best.

Varietal differences exist. Most early varieties and Cortland appear to be especially difficult to completely defruit chemically.

Peaches

Most peach varieties set much more fruit than the tree can mature to marketable size. Further, the structure of overloaded, non-thinned trees may be destroyed through branch breakage even before the crop is mature. Fruit thinning reduces branch breakage, increases the tonnage of marketable fruit but reduces the total crop.

THINNING METHODS

Hand Thinning is most commonly accomplished by hand labor. Workers using a child's plastic bat or a rubber-hose thinning aid remove much of the excess fruit and supplementally hand thin. Ideally, early varieties are thinned 15 to 20 cm (6 to 8 in.) apart (two to three fruits per shoot). There is little likelihood of overthinning early varieties when the set is heavy.

Late-maturing varieties are thinned according to their individual requirements. Heavy-setting, hard-to-size varieties such as Redhaven require heavier thinning than the easier-to-size types like Golden Jubilee and Loring. As a rule of thumb, however, late-maturing varieties with a good, uniform set are usually thinned 10 to 13 cm (4 to 5 in.) apart. Distance between fruits is not too critical as long as clusters are broken up and fruits separated. If the set is spotty on the tree, more fruits may be left on heavy-set branches.

Chemical: There is no truly satisfactory chemical available. Dinitro materials such as Elgetol applied during full bloom may provide satisfactory results in the Niagara Peninsula. Dinitros should not be used in areas and seasons where the risk of late spring frost is high. In orchards where a dinitro can be used safely, it should be applied when 90 to 95% of the blossoms are open. It is preferable to spray a little early rather than after blossoms have been open for some time. Elgetol, for example, may be used at 1.25 to 3.75 L per 1000 L of water, depending on variety. Trees under five years of age should not be chemically thinned.

Mechanical: The trunk-shaker method supplemented by touch-up hand thinning is now being employed by several growers. The major drawback of this method is that stiff branches are easily overthinned, while willowy or hanging branches are generally underthinned.

It is strongly recommended that an observer accompany the machine operator to help him avoid overthinning. Little is known about short- or long-term damage (if any) caused to feeder roots by mechanical shakers.

Particular care must be exercised in follow-up hand thinning. It may well be necessary to leave more fruit than normal on some of the underthinned branches partially to compensate for excessive thinning on others.

Plums

The dinitros will thin plums more easily than peaches. Where biennial bearing is occurring, or where size is difficult to attain, bloom-thinning can be helpful. Elgetol at 1.25 L per 1000 L of water is a suggested strength to try.

Pears

Response of pears to chemical thinning agents tends to be inconsistent from year to year. When timing of application according to fruit size has been properly worked out for pears, weather conditions may not play as important a part. With Bartlett and Anjou, try NAA three to six days after petal fall at 10 to 15 ppm, or NAD at 10 ppm two to three days after full bloom, followed by NAA at 10 ppm three to six days later. For Keiffer and Winter Nelis, NAD at 15 to 20 ppm two to three days after full bloom, followed by NAA at 10 ppm three to six days later, is suggested.

CHEMICAL CONTROL OF PREHARVEST DROP OF APPLES

Varieties differ in their tendency toward preharvest drop. In this respect, the McIntosh gives the greatest concern in Ontario.

Drop tends to be greater with trees in which the nitrogen content is high during the late summer and with trees carrying a very high crop. Hot days and warm nights just before and during harvest tend to increase the amount of preharvest drop.

Several synthetic hormone substances have been used to control preharvest drop. The best known of these are NAA and daminozide.

NAA (naphthaleneacetic acid) such as Niagara-Stik, Bartlett-Stik, and Fruitone-N.

This is the same material that is used earlier in the season for thinning the crop. The concentrations differ for the two purposes.

NAA is effective for 7 to 12 days after spraying. Longer holding can be obtained by repeated application (of single strength) every 7 days.

Apply NAA before the drop of normal, sound fruit commences, at the rate of 10 ppm. One application of single strength has little effect on direct ripening of the fruit. However, the higher the concentration of NAA used and the greater the number of applications, the greater will be the ripening effect.

Notes and Precautions for NAA

1. Trees must be in a healthy, vigorous condition in order to respond satisfactorily to a preharvest spray.
2. NAA sprays applied too early, or those applied after drop has commenced, are not effective in controlling preharvest drop.
3. NAA **sprays can be applied in concentrate form, but it is preferable to apply as a dilute spray. They should be applied alone rather than in combination with a pesticide.**

Daminozide (Alar 85)

Alar has to be applied much earlier in the growing season than the other stop- drop materials. Alar is a growth regulator and can delay fruit maturity.

With McIntosh, Alar should be applied 60 to 70 days prior to the normal harvest date. Early varieties, such as Melba, can be sprayed closer to harvest (45 days). Rates of application depend upon tree vigor, variety and crop load, and should vary from 2.75 to 4.5 kg/ha. High rates on low vigor trees can reduce fruit size.

General Precautions

1. Alar delays maturity. For this reason, spray only a portion of the planting in order to schedule the harvest sequence. Harvest of Alar-treated fruit should be delayed 7 to 10 days until the fruit reaches acceptable maturity. If the harvest is delayed excessively, do not place the fruit in controlled atmosphere storage or in extended cold storage.
2. If high rates of Alar are applied, if trees of low vigor are sprayed, or if Alar application is delayed, a significant increase in fruit set can occur the following season. Growers should be aware of the possibility and be prepared to apply chemical thinners at the normal rate and proper time in order to break up the clusters.
3. Alar should not be applied to the same trees more than one time during the season. It is essential that Alar be used as part of a well-designed orchard management program in which the trees are maintained in a satisfactory state of vigor to prevent adverse effects on fruit size and cropping.

4. High rates of Alar can result in softer apples after prolonged storage.

GROWTH REGULATORS TO PROMOTE FLOWERING AND FRUIT SET

The following information is suggested for trial use under the grower's specific conditions.

Apple cultivars can be induced to flower by the application of either ethephon or daminozide applied alone or in combination. Experience has shown that on non- bearing trees both materials will promote flowering but the daminozide will increase fruit set the following season under Ontario conditions.

Daminozide (Alar)

Alar-85 applied two or three weeks after petal fall on non-bearing Northern Spy at the rate of 3.25 to 6.75 kg/ha is effective in promoting flower bud formation and fruit set the following season. The rate of application depends upon tree age, rootstock, vigor of the trees and density of the planting.

Alar-85 applied to bearing trees two or three weeks after petal fall can significantly reduce fruit size and is not recommended except in specific conditions. With a heavy fruit crop, Alar-85 alone will not promote return bloom.

Daminozide (Alar-85) plus Ethephon (Ethrel) Applied two to three weeks after petal fall to non-bearing trees, this combination can promote flower bud formation with most cultivars. Rates of 2.25 kg Alar-85 plus 1.5 to 2.75 L Ethrel per hectare are effective. The rate of Ethrel depends upon the vigor of the cultivar, rootstock and orchard.

On bearing trees, 1.1 kg Alar-85 plus 1.5 L Ethrel per hectare can be used on McIntosh but the application has to be delayed until five to six weeks after petal fall. The application should be made only to vigorous trees and on a trial basis. Ethrel does a certain amount of thinning. On McIntosh, fruit color has been improved with limited effects on storage quality. With other cultivars maturity and quality may be altered. Fruit size will be reduced from the Alar-85 plus Ethrel treatment.

Ethepron (Ethrel) Ethrel applied two to three weeks after petal fall on non- bearing apple trees at the rate of 1.5 to 2.75 L/ha promotes flowering of most cultivars. Applications made to bearing trees two to three weeks after petal fall can cause excessive thinning of the existing crop. The amount of fruit removed cannot be forecast accurately.

ETHEPHON TO PROMOTE FRUIT COLORING AND ADVANCING APPLE MATURITY

Ethephon (Ethrel) has the following effects on trees and fruit, depending upon the time and rate of applications:

1. Ethrel stimulates ripening, color development and fruit drop. The fruit may all be on the ground one week after spraying unless a suitable stop- drop is used. Alar applied at the normal rate in mid-season is not an effective stop-drop to be used with Ethrel. Two applications of naphthaleneacetic acid (NAA) (e.g. Bartlett-Stik or Niagara-Stik) are required: one as a tank mix at the time Ethrel is applied and the second five days later. Apply the stop-drop at the rate recommended on the label.
2. **Spray just the number of trees that can be harvested over a two- or three- day period.** Following the spray application the fruit will have to be harvested within 5 to 10 days. After spraying, check the maturity of the apples on a daily basis (e.g. pressure, starch, flavor, color). A few trees sprayed at three- to four-day intervals would be easier to manage than a large number sprayed at one time. **A market should be available for the treated apples before they are sprayed.**
3. Development of red color depends upon exposing the fruit to adequate sunlight. Ethrel will not substitute for light in poorly pruned trees of high vigor. Under these conditions the response is disappointing.
4. Ethrel should not be applied during periods when the trees are under severe heat and moisture stress. Under these conditions, tip dieback has been observed the following spring on early varieties.
5. If left on the tree the fruit continues to ripen and mature at a rapid rate. Harvesting and rapid cooling will slow the ripening process. Fruit treated with Ethrel should not be kept in cold storage for more than one to two months. The storage life depends upon the maturity at harvest and how the fruit is handled after harvest. Fruit placed in storage should be marked for early sale. Ethrel-treated apples should not be placed in CA storage.
6. Rates of application depend upon the variety, date of application, tree vigor temperature, weather conditions and degree of response required. The response to Ethrel is a chemical reaction and as such is dependent upon temperature. For this reason early varieties such as Red Melba and Early McIntosh require less material than later varieties. Lower rates do not give as rapid a response but allow picking over a longer time interval due to a slower ripening. Longer storage life may be possible with lower rates.

   On early varieties such as Red Melba and Early McIntosh, use 0.75 to 1.5 L of Ethrel per hectare applied with sufficient water to wet the trees thoroughly.

   McIntosh requires 1.5 to 4.25 L/ha. The higher rate is used early in the season, on trees that are high in nitrogen, or on trees that are poorly pruned. Lower rates may be advantageous nearer the normal harvest, on young, well-pruned trees, or on trees that are low in nitrogen.

   More color response has been obtained if the Ethrel and stop-drop are applied following the normal late-July application of Alar at the recommended rate. With high nitrogen and excessively vegetative McIntosh trees, the results may be more consistent with Ethrel sprays following Alar.

   Following Alar, lower Ethrel rates are effective in promoting color. NAA must still be applied.
7. Ethrel should be used with caution. **READ THE LABEL.**

PROMALIN TO IMPROVE FRUIT SHAPE OF DELICIOUS

Promalin® (Abbott Laboratories, North Chicago, Ill.) has recently been registered for use on "Delicious" strains in Ontario to increase the "typey" appearance of the fruit (elongation and more promiment calyx lobes). Careful timing of the application, close adherence to recommended rates, and complete coverage are essential to satisfactory results. Application of higher rates or volumes per hectare than those recommended on the label may result in undesirable fruit thinning. Concentrated applications are not recommended at this time. For optimum results the application should be made between the king bloom balloon stage and full bloom. Applications earlier or later than this recommended interval are likely to produce an unsatisfactory response.

Strains of "Delicious" seem to respond equally to Promalin application. The response will appear to be better on the naturally more-typey strains. Postbloom weather has a strong influence on the development of typiness and will affect the response to Promalin as well. Growers interested in using Promalin should familiarize themselves with the material through carefully applied trial applications to small blocks, leaving some trees untreated for comparison.

SCALD CONTROL OF APPLES

Materials Used

Ethoxyquin and diphenylamine are the two materials used. Ethoxyquin is less liable to cause injury than diphenylamine on varieties such as Golden Delicious, but also may be less effective. These chemicals are available from several sources: formulations from suppliers may differ in concentration of active ingredient and in behavior.

General Recommended Concentrations

Because formulations may contain different concentrations of active ingredient, the recommended concentrations are given in parts per million (ppm). These can be recalculated on a volume basis using recommendations on the labels of the individual formulations. **READ THE LABEL.**

Ethoxyquin:	All uses – 2700 ppm ai.
Diphenylamine:	Preharvest spray – 2000 ppm ai on most varieties, 1000 ppm ai on Golden Delicious and other injury-susceptible varieties such as Rome Beauty.
Postharvest:	1000 to 2000 ppm ai.

Application

Preharvest spray: Use ethoxyquin at a rate of 2700 ppm ai. For most varieties use diphenylamine at a rate of 2000 ppm ai. Rome Beauty and Golden Delicious should receive half the dosage cited above (1000 ppm ai) of diphenylamine.

Sprays should be applied within 24 hours of harvest. The trees should be sprayed to the drip stage making sure that the fruit is covered. Materials should be well agitated in the spray tank. Hand-gun applications may be more effective than air blast. The tank should be flushed before refilling, and the solutions should not be used if over two days old. If harvest is delayed beyond the 24-hour period, or if it rains, the trees should not be resprayed with the same material as this could lead to residues beyond the legal limit. However, ethoxyquin might be used after diphenylamine and vice versa. Do not spray if the temperature is higher than 27°C.

Because of difficulties in getting through the orchard with a spray rig at harvest-time, the need for picking within 24 hours of application, the higher cost of preharvest sprays and the uncertainties of weather, postharvest treatment is preferred to the preharvest spray.

Postharvest treatment: Use ethoxyquin at 2700 ppm ai. With diphenylamine, 1000 ppm ai is usually sufficient and there is considerably less chance of injury than when using 2000 ppm ai which may give better control of scald. On Cortland, because of its extreme susceptibility to scald, use 2000 ppm. If there is a history of scald development in a particular strain, or fruit from a particular orchard, use 1500 to 2000 ppm diphenylamine.

Methods of application include: (a) dipping the boxes or bins of fruit into a tank containing the solution; (b) spraying or dipping the loose fruit; and, (c) using an overhead drench type of applicator. The overhead drenchers may be for individual bins or for truckloads of fruit. Irrespective of type of treatment, good coverage of each apple is important for control of scald, and good drainage is important to minimize injury. For best results, apply immediately after harvest, although there may be some effect for up to two weeks after harvest. The fruit temperature should be between 16 and 27°C. If the temperature is too low, effectiveness is lost; if too high, there may be injury. For similar reasons the temperature of the material should be between 10 and 32°C.

The material in the tank should be kept well agitated. Fresh material should be prepared after treatment of 2000 bushels (100 bins) per 100 gallons and when it becomes too dirty. The system should be fitted with a filter so that dirt which might cause surface discoloration of the apples is not recirculated. All fruits should be covered throughly, and provision should be made for draining off the excess material. With ethoxyquin, because liquid is removed during treatment, premixed dilute solution should be kept on hand for topping up the treatment tank or reservoir; topping up with water will weaken the solution and make it less effective. Because diphenylamine is in suspension and the active ingredient may be removed on the fruit without the corresponding amount of water, the strength of the suspension may decrease with time, and even adding premixed material may not restore the original concentration. There is no easy way to check the strength of the suspension. However, changing the material after treatment of 100 bins per 100 gallons of solution and adding premixed material as makeup solution should ensure that the suspension does not become diluted and ineffective. Test kits are now available to check the strength of the suspension but they are costly.

Precautions

When using for the first time as a postharvest application, trial on only a limited volume of fruit is recommended. Because of possible injury ethoxyquin is the preferred material on Rome Beauty and Golden Delicious. There have been some reports that ethoxyquin may reduce the yellowing of Golden Delicious coincident with normal ripening. Diphenylamine is the approved material on Idared because there have been reports of a bitter flavor when ethoxyquin was used on this variety. This effect has been attributed to using year-old material. Obviously the use of new material is advisable. Some people may be sensitive to the two materials, and this may necessitate wearing gloves.

Postharvest applications are more positive and less expensive than field applications, but may cause more injury. In a really bad scald year no treatment may be 100% effective. Although scald may develop in storage, further scald development occurs when the fruit is held at a high temperature during the poststorage marketing period. Fruit samples should be removed from storage at monthly intervals and held at room temperature to check on the occurrence of scald. This is particularly true of apples held in CA storage. Some other disorders may confuse identification of common scald. Jonathan Spot on Idared, skin discoloration resulting from internal breakdown, and external low-O_2 injury may be confused with common storage scald.

The directions on the labels of the chemical containers should be read and understood before beginning treatment. Residue tolerances have been set by the Food and Drug Directorate, and misapplications may result in residues above legal tolerances.

In other countries, tolerances may vary. Thus, persons planning export should check with the Canadian Horticultural Council in Ottawa. Pomace from apples treated with diphenylamine should not be fed to animals as this may lead to residues above the zero tolerances for meat and milk. There is no legal requirement in Ontario for labeling apples treated after harvest. However, in New York and Michigan such labeling is required for apples treated with ethoxyquin and diphenylamine after harvest.

CA STORAGE RECOMMENDATIONS FOR APPLES

General Considerations

1. Cultivars (varieties) should be stored together only if

recommended temperatures, atmospheres and harvest-times correspond. Benefit of CA or any other kind of storage is realized only when apples are mature, but not ripe, when put in storage. Holding one cultivar of apple in cold storage until the room can be filled with a cultivar harvested later is not a good practice. In New York there is a limit on the filling time of CA rooms, but not in Ontario.

2. The 2.0 to 2.5% limit on CO_2 level used for McIntosh in the first month (see Table 1) is important in lowering the susceptibility of the fruit to CO_2 injury. In some years and in some areas this may not be necessary, but is a precaution that should not be ignored as just another inconvenience. The temperature should not go below 2°C (36°F) for McIntosh, or there can be a high incidence of brown core and stem-cavity browning.
3. Injuries may be caused by low O_2 levels and high CO_2 levels. The O_2 level should not be below 2.5% (See Low-O_2 storage.) and the CO_2 level not more than 0.5% above the recommended level. Low CO_2 levels will not harm the fruit directly, but the recommended level of 4.5%-5.0% is important, especially in reducing the rate of softening of McIntosh. Those operators using supplemental scrubbing with lime directly in the room should not use much more than the recommended amounts or the CO_2 level may not rise to 4.5%-5.0% as quickly as desirable.
4. The atmospheres recommended have generally been selected after a great deal of experimental work and accumulation of practical knowledge. Although some variation from the recommended conditions must be expected, and in some years considerable variation may do little harm, it is wise to maintain the atmospheres close to those recommended. The amount of variation will depend on the mechanical suitability of the rooms and the equipment, and the experience and skill of the operator.
5. The freezing point of apples is the −2.0 to −1.5°C range. Storage at −0.5°C may give some extra storage life but is also risky. Distance temperature sensing devices should be used to measure temperature in areas remote from the access door at which thermometers may be visible through a clear plexiglass panel. There may be areas in the room in which the temperature may be considerably different than at the front because of poor air circulation and/or inadequate insulation. Thermometers should be calibrated before use with a stirred water ice-water mixture which should give a temperature of 0°C (32°F)

TABLE 15. RECOMMENDED CA CONDITIONS FOR APPLES IN ONTARIO

Cultivar	Temperature °F	Temperature °C	Relative Humidity %	Atmosphere (%) O_2	Atmosphere (%) CO_2
McIntosh	37-38	3	95	2.5-3.0	2.0-2.5 the first month then 4.5-5.0
Cortland (see note below)					
All other cultivars	32	0	95	2.5-3.0	2.5-3.0

Notes on Some Cultivars

Cortland Research in New York has shown that Cortland may be held at either recommendation in Table 1. Choice of conditions may depend on harvest date and space available.

Idared Idared stores well in cold storage at 0°C (32°F). However, there may be some advantage to CA for long-term storage. Jonathan spot on Idared is controlled in CA. Some years ago there was some concern that CO_2 in the atmosphere caused a browning of the core in Idared. Our recent research has indicated that this disorder could occur, but only at a CO_2 level of 5% or more. Therefore, keeping the CO_2 level at 2.5% or lower may be a good safety measure.

EMPIRE AND SPARTAN

We have had experience for five years with these two cultivars in small-scale trials. This experience and results from other places indicate that they store well at 0°C (32°F) and the atmosphere recommended for "all other cultivars" in Table 1.

For further details on CA storage, refer to Ontario Ministry of Agriculture and Food Publication 431, Harvesting, Storing and Packing Apples, which has just been revised.

LOW-O_2 STORAGE

Research is ongoing with what is now called low-O_2 or ultralow-O_2 storage. Research and commercial trails in Ontario have shown the potential benefit of this treatment on McIntosh. The simplest O_2-CO_2 combination appears to be 1% O_2 plus less than 1% CO_2 with the latter scrubbed by lime placed inside the room. The temperature used has been the normal one for McIntosh in CA, that is, 3.0°C. There is some evidence that early harvested McIntosh are less likely to be injured than later harvested fruit.

In England where this low-O_2 recommendation originated for Cox's Orange Pippin, researchers regard low-O_2 storage as too risky for commercial operation without constant monitoring and correction of atmospheres with electronic instrumentation including analyses for alcohol as an indication of incipient low-O_2 injury. However the storage operators in Ontario using this technique have made most analyses with the Orsat analyzer. Considering that the variability of measurement with an Orsat is at very best + 0.1% and there may be sampling error, holding a room at 1% O_2 is hazardous. Because of the variability in analyses and in actual atmosphere concentration, it is also possible to get low-O_2 injury without improving the firmness of the fruit. Operators attempting low-O_2 storage should ensure that they can sample fruit from the room frequently. These fruits should be checked for visible symptoms externally and internally for low- O_2 injury, and also tasted for off-flavors, both one day after removal from storage and after a week in air at 20°C. In the absence of an alcohol analyzer this may be the best that can be done, but in some cases the sensitivity of the alcohol analyzer has not been adequate to detect injury. If there is a high incidence of symptoms of injury in the sample the atmosphere of the room should be changed to air.

Overall the possibilities for injury by low-oxygen conditions and the unknown variables influencing injury do not permit a general recommendation for Ontario.

POSTHARVEST DIPS FOR STORAGE ROTS

Storage rots occur from infections of the fruit through wounds. Proper sanitation of the storage and handling equipment is necessary to help reduce infections. Infection of wounds in the dip tank is a common occurrence. The addition of a fungicide to the dip tank will help prevent these infections. Subsequent infection in the storage will also be prevented by this treatment. Fruit already infected will not benefit from this treatment.

Fungicide	**Amt per 1000 L**
* benomyl 50% WP or	500 g
** thiabendozole 42% F or	1 L

** Benomyl and thiabendozole will not control alternaria rot.*
***Do not use with Stop-Scald.*

MOUSE CONTROL IN ORCHARDS

In September, look for signs of mice-fresh grass clippings in runways, droppings, tunnels and chewed apples. All baits are more effective if dropped apples are picked up from under the tree.

As a supplement to poisoning, remove straw, trash, sod, etc. from around the base of the tree in the fall for at least 60 cm from the trunk. If possible, pick up all dropped apples before setting out poisoned baits.

In the fall, before the ground is permanently covered with snow and before the grass falls over, broadcast the bait evenly on the floor of the orchard.

Baits available

1. Waxed Zinc Phosphide – 5.5 to 11 kg/ha depending on the severity of infestation. When further mice activity is detected, repeat the treatment when rain is not expected.
2. Diphacinone (Ramik Brown) – 22 kg/ha in two applications of 11 kg each. Application can be made 20 to 40 days apart.
3. Chlorophacinone (Rozol, K$_5$C^5) – 11 kg/ha. Repeat in 20 to 60 days where infestation is high.

CAUTIONS IN HANDLING POISON BAITS These baits are poisonous to human beings, domestic animals and wildlife.

Store the bait in a shed away from children, irresponsible persons and animals. Wear rubber or neoprene gloves for hazardous compounds and wash after handling poison baits. Avoid inhalation of dust or fumes. Destroy empty containers by burning or burying in non-cropland away from water. Keep children, pets, and domestic animals away especially from treated areas. Where possible remove mouse bodies and bury or dispose in garbage.

Tree Guards for Mice

Set wire tree guards of galvanized wire mesh around the trunk. Set them about 8 cm deep in a mound of fine crushed stone or sharp cinders. Check the guards each fall to see that they are mouse-tight and free of trash. Tree guards are especially valuable in protecting young trees for a long period.

A number of other materials are suitable for mouse guards, e.g. heavy aluminum foil. A number of commercial tree guards are available, such as spiral plastic tree guards. Do not use dark colored plastic or tar paper since these can increase the temperature of the bark on sunny days. Subsequent lower temperatures can cause winter injury. Spiral plastic tree guards should be adjusted annually to prevent guard from interfering with trunk expansion.

RABBIT CONTROL

Rabbit Repellents

Rabbit repellents containing thiram appear to be superior to the old rosin-alcohol mixtures, although some failures are being reported. A number of commercial thiram rabbit repellents are available. Consult the directions on the container. Be sure to treat the tree as high as rabbits can reach when standing on deep snow. The repellents may be applied with a small knapsack sprayer or painted on with a brush. Thiram can be mixed with white latex paint used to protect trees against Southwest injury (see page 72).

Shoot the Rabbits

Shooting rabbits is an excellent means of keeping the population down. However, it must be done regularly throughout the year because other rabbits soon move into the orchard area. Shooting alone cannot be depended upon to provide adequate control.

Wrapping Young Trees

Wrap sacking about the top and the trunk above the mouse guard to protect young trees from rabbits. Tie the wrapped tree securely to a strong stake or steel fence post to prevent snow and ice breaking the tree over. Mouse guards generally do not give protection against rabbits when the snow is deep.

Repairing Damage by Mice and Rabbits

Regular inspection should be carried out throughout the winter to see if any injury has occurred. Mice work just below the surface of the snow or litter. If a tree has been wholly or partially girdled, it should be given first aid immediately. Cover the wound with a grafting compound or a wound dressing.

Before the buds swell in the spring, secure enough long scions to bridge the wound. See OMAF Factsheet, Repair Grafting, Agdex 210/24. Store the scions in damp sand or sawdust in a cool place. If the wound extends for more than one quarter of the circumference of the trunk, bridge graft in the manner described in Factsheet, Repair Grafting. This should be done when the bark slips readily from the wood, generally about May 24.

CONTROL OF GROUNDHOGS IN ORCHARDS

Winter is a poor time for control as the woodchuck is hibernating in a sealed-off chamber in its burrow.

1. **Phostoxin** (fumigant): This product is manufactured in tablet form. Packages contain three tubes with 30 tablets per tube, or a total of 90 tablets. Rate of application is one tablet per hole. All entrances must be sealed to prevent gas from escaping.

   Phostoxin contains aluminum phosphide. In the presence of moisture, phosphide gas (phosphine) is released, which is claimed to be effective against groundhogs. The distributor of this material, Abell Waco Ltd., requires the user to take instruction on using this product before it can be purchased. (A Factsheet, Aluminum Phosphide for Groundhog Control, is available from the Ontario Ministry of the Environment.)
2. **Gas Cartridges:** These are cardboard cylinders containing a mixture that burns slowly and asphyxiates the groundhog. The cartridge is placed in the burrow of the groundhog and all entrances must be sealed. Follow manufacturer's instructions on the preparation and use of cartridges.
3. **Trapping:** This method can be effective for groundhog control; however, it is timeconsuming. No. 2 steel traps (muskrat traps) are most practical. Traps should be checked at least twice a day and should be cleaned after each catch.
4. **Shooting:** This can be an excellent means of keeping groundhogs under control. However, it must be done regularly from spring to fall.

BIRD DAMAGE AND ITS PREVENTION IN ORCHARDS AND VINEYARDS

Every year, birds destroy large quantities of fruit in Ontario. Cherries, grapes and blueberries are crops most subject to attack, but other fruit crops may also be damaged. Losses of

25% for sweet cherry and 10% for grape crops are not uncommon, although the extent of fruit damage varies greatly among varieties, location and seasons. Pecking and puncturing damage is usually greater than actual losses from fruit consumed.

Several bird species are responsible for damage to ripening fruit crops. Among the most destructive are robins, starlings, grackles and orioles. A report published by the Canadian Wildlife Service identified adult robins and grackles as the main culprits damaging early ripening sweet cherries; starlings and, to a lesser extent, juvenile robins cause most of the damage to later ripening cherries. Grapes are taken mainly by robins, but flocks of starlings do cause periodic damage. Migrating Baltimore orioles reportedly limit their attack mainly to early ripening table grapes during late August.

Birds show definite preference among fruit varieties. The Wildlife Service Report implicated fruit color differences as the explanation for this varietal preference. Robins, grackles and starlings commonly select the reddest cherries or darkest grapes available. Early ripening black sweet cherries and French hybrid grapes are, therefore, particularly susceptible to bird damage. Small-berried, early ripening, blue varieties of grapes such as Leon Millot and Marechal Foch are often stripped rather than pecked.

Methods of Control

Discussion herein of certain drastic control measures does not imply their universal recommendation. In all cases, local, provincial and federal laws governing killing of birds, or the use of sound-scaring devices, must be followed.

Location The location in which commercial fruits are planted can be an important factor in the control of birds. Cherry orchards growing near a wooded area are particularly susceptible to damage as birds find shelter and nesting sites close by. Similarly, small fruit plantings near hedges are particularly vulnerable.

Physical Protection The only completely foolproof method of control is to cover plants with netting physically preventing birds from getting at the fruit. This method may be economically feasible for grapes and highbush blueberries but would seem impractical for tree fruits.

Shooting Shooting starlings and grackles is still a very practical control method. Normally shooting does not materially reduce the bird population, but serves primarily as a technique to frighten them out of the orchard. Robins and Baltimore orioles are protected by an act of parliament, but special permits may be obtained to kill them when they are shown to be causing damage. Shells are also available with delayed explosions and/or sustained whistles which disorient and frighten the birds.

Automatic Exploders One of the most commonly used bird controls is the automatic exploder. This is an acetylene- or butane- powered, cannon-like machine set to produce loud gunshot sounds at intervals. Robins soon become accustomed to these and are sometimes observed perched fearlessly nearby the devices while they explode. Automatic exploders are particularly effective when used in conjunction with shooting.

Av-Alarm The Av-Alarm is the latest and most effective device available. It sends out an electronic sound which apparently deafens birds temporarily, causing them to move out of an orchard after one or two days of exposure. The Av-Alarm has been widely used in Ontario and has effectively prevented bird damage to sweet and sour cherries, grapes and other fruit crops.

Chemical Controls Methods of chemically controlling birds attacking fruit crops have NOT been studied in Ontario. Most of the research effort has been devoted to Avitrol on field corn.

Other Methods Other control methods tried include broadcast distress and alarm calls, aluminum foil hung in trees, model hawks, strips of yellow plastic hung across vineyards, scarecrows with power-driven moving arms, trapping, and various noisemakers. These have met with only limited success.

CONTROL OF SOUTHWEST INJURY ON FRUIT TREES

Southwest injury (winter sunscald) occurs during the winter and is especially severe when cold sunny days are followed by cold clear nights. Injuries are usually confined to the south and southwest sides of the trunks and main scaffold branches. On sunny days these tissues become considerably warmer than the surrounding air and at night they cool rapidly; freezing of the bark may occur. Freezing injury usually affects large portions of the bark tissue which becomes brown and will eventually slough off as healing occurs beneath. In stone fruit orchards, these injuries provide ideal sites for infection by the peach canker or other canker diseases. The combined effect of southwest injury and peach canker greatly reduces the productive life of affected trees.

Southwest injury can be prevented and peach canker reduced by painting the trunk, crotches, and lower parts of main scaffold branches with exterior white latex paint. OIL-BASED PAINTS SHOULD NOT BE USED. They contain toxic materials which may injure or kill fruit trees. Latex paints which contain some oil should not be used either. The white paint reflects sunlight and prevents the tissues exposed to direct sunshine from rapid thawing on cold days when air temperatures are below freezing. Rapid thawing in the day and freezing at night are prevented by the paint and thereby reduce freezing injury.

October is the best time to apply the paint. Best results are obtained when trees are painted on days when the temperature is above 10°C and conditions favor rapid drying. The paint may be applied by brush or by spray. On young trees, the whole trunk should be painted; but on older trees only the south and southwest sides of the tree require painting. The whiter the bark after painting, the greater the protection.

On young trees, one to three years old, injury from rodents may be a greater problem than southwest injury. To obtain protection from both problems, thiram (75% white WP) should be incorporated into the paint*. Thiram acts as a taste repellent for rodents and helps to prevent infection by peach canker. Mix 400 g of thiram with 2 litres of water and stir slowly into 4 litres of paint. This mixture may also be used effectively as a wound dressing. On older trees where rodent damage is less of a problem, the thiram can be left out and the diluted paint used by itself. One or two quarts of water per gallon of paint may be necessary if the material is applied by spray, depending on the thickness of the paint and the air pressure available.

**A number of commercial pre-mixtures are also available.*

Note that the thiram-latex mixture should not be used if a full bordeaux spray program is planned. The thiram reacts with the bordeaux spray, changing the color of the paint from white to brown, and reducing its effectiveness as a heat reflectant. The bordeaux spray does not affect trees painted with latex only and can be used when thiram is excluded from the mixture. If the thiram-latex mixture is planned as a combined rodent repellent and protectant from southwest injury, then the whole trunk must be painted and good coverage at the soil line is very important to prevent mouse damage.

NEMATODES

Root-lesion nematodes can be a major cause of orchard replant failures. They can also cause a decline in vigor of existing peach and cherry orchards. These nematodes kill the fine feeder roots and cause small brown lesions on the white lateral roots. These lesions can merge and discolor the entire root system. Severely affected trees may not have any feeder roots and if the tree is a replant it usually dies. The most striking aboveground indication of nematode damage in an orchard is a general lack of uniformity of trees.

Root-lesion nematode damage on strawberries usually consists of a discoloration of the fine feeder roots and tiny, brown, scratch-like lesions on the young adventitious roots. These lesions merge to form large brown areas on the roots. There is also evidence that root-lesion nematodes are involved in the black root-rot complex and that they aggravate verticillium wilt of strawberries.

Preplant soil fumigation is the cheapest and most effective method of controlling nematode problems and is practical when planting a new orchard, when replanting an orchard or an old tree site. Soil fumigation should be done in the fall when the soil temperature is at least 4°C. Custom operators can do either broadcast fumigation or tree-row, tree-row application (treating a 2.0-2.5 metre strip centered on the row) is more economical. However, broadcast fumigation is necessary if a grower is going to interplant with a crop such as potato or strawberry.

Nematode and other problems in orchard, and strawberry and raspberry plantings can be controlled with the following chemicals:

TABLE 16. CONTROL OF NEMATODES AND OTHER PROBLEMS IN MINERAL SOIL IN ORCHARDS AND IN STRAWBERRY AND RASPBERRY PLANTINGS

	Material	Broadcast (L/ha)	Tree Site (mL/injection)	Control
(I)	**ORCHARDS**			
	D-D	360	1.3	nematodes
	Telone IIB	200	0.8	nematodes
	Vapam*	550-900	—	nematodes, weeds, diseases
	Vorlex	55-130	0.2-0.5	nematodes
	Vorlex	225-450	0.8-1.7k	nematodes, weeds, diseases
(II)	**STRAWBERRY & RASPBERRY**			
	D-D	220-280		nematodes
	Telone IIB	170		nematodes
	Vapam*	550-900		nematodes, weeds, diseases
	Vorlex	55-130		nematodes
	Vorlex	225-450		nematodes, weeds, diseases

**Vapam is applied by shank injection or in irrigation water ("chemigation"). See label for tree site instructions.*

Always follow manufacturer's directions carefully concerning dosage and methods of use. Preplant fumigation is most effective when:

1. It is done in the fall when soil temperatures are above 4°C.
2. Trash and old root systems are removed; the soil worked to a depth of 25 to 30 cm and in good seedbed condition with regard to tilth and moisture.
3. The fumigant is injected about 20 cm deep.
4. The soil surface is sealed by packing or watering immediately after injection of the fumigant.
5. The soil is left undisturbed until spring or, in the case of fall planting, at least one week after injection of the fumigant.
6. The soil is worked and aerated for about a week before planting. For fall planting the soil should be aerated at least two weeks after working.
7. Good nursery stock grown preferably in fumigated soil.
8. Italian Rye Grass is used as an annual cover crop in cultivated orchards; Kentucky Tall Fescue or Creeping Red Fescue is used as a permanent sod. These three grasses are poor hosts of the root-lesion nematode.

The procedure for preplant fumigation of tree sites is the same as that described above except that the fumigant is injected with a hand applicator (Fumigun) on 20 by 20 cm centers over a 2.5 by 2.5 m area. Fumiguns can usually be rented from custom applicators or pesticide dealers.

Postplant Treatment (Non-Bearing Apples)

Postplant treatment of non-bearing apple trees for control of root-lesion nematodes can be achieved with oxamyl ("Vydate L" = 240 g active oxamyl/L). Apply a liquid soil drench application soon after planting. The liquid soil drench is mixed at 1.25 litres Vydate L/1000 L water, and applied at 3.5 - 10 L of drench mix per tree, in a circle around the base of the tree to cover the root zone. Do not use if temperature is below 7°C as slight injury may occur. Follow with a foliar spray three weeks to a month later. The foliar spray mix is 4.1 - 8.2 litres Vydate l/1000 L water applied at not over 9.3 L Vydate L/ha in any one application. For non-bearing apple trees already established, apply the liquid soil drench application soon after petal fall and follow with a foliar application three weeks to a month later.

Root absorption of Vydate L occurs during periods of rapid root growth (early spring). Foliar absorption occurs best in young, rapidly expanding foliage. See the manufacturer's label for further details, precautions and methods of application.

Areas that harbor potential nematode problems should be treated before planting. For details concerning nematode problems and preplant soil fumigation, consult your Horticultural Crop Advisor. OMAF Factsheets available are: *Root-Lesion Nematode in Ontario Orchards; Soil and Root Sampling for Nematode Analysis: Nematode Control Guidelines for the Application of Soil Fumigants*; Agdex 608 and *Soil Fumigants*, Agdex 606.

CROP INSURANCE

The Government of Ontario, in cooperation with the Government of Canada has developed a comprehensive scheme of crop insurance protection. The Canada - Ontario Crop Insurance Program is administered by the Crop Insurance Commission of Ontario.

The Government of Canada provides financial assistance to this program by contributing 50% of the total required premium each year. In 1983 the contribution by the Federal government amounted to 20.5 million dollars.

The Government of Ontario contributed 3.0 million dollars for administering the program in 1983. As a result, this valuable protection is available to Ontario growers at less than half the total cost. The premium is also an operating expense for income tax purposes.

Crop insurance offers protection against loss from a broad range of production hazards including excessive rain, excessive drought, winter damage, frost, hail, wind, certain pests and diseases, etc.

TABLE 17. CROPS FOR WHICH A CROP INSURANCE PLAN IS AVAILABLE IN ONTARIO INCLUDE:

Vegetables

* Beans (green and wax, processing only)
Beets
Broccoli
Cabbage
Carrots
Cauliflower
Celery
Cucumbers
Lettuce
* Lima beans (processing only)
Parsnips
* Peas (processing only)
Peppers
Potatoes
Pumpkins
Rutabagas
Seed onions
Set onions
Spanish onions
Squash
Sweet corn (fresh)
* Sweet corn (processing)
Tomatoes
* Tomatoes (processing)

Fruit Crops	**General Crops**	**Tobacco**
Apples	Corn (grain and silage)	Flue-cured
Grapes	Hay	Burley
Peaches	New forage seeding	Black
Pears	Seed corn	
Plums	Spring grain	
Sour cherries	Soybeans	
Strawberries	White beans	
Sweet cherries	Colored beans	
	Winter Wheat	

** Insurance contracts available through processing companies only. Insurance contracts for all other crops available from crop insurance agents only.*

For further information contact your local crop insurance agent or: The Crop Insurance Commission of Ontario, Ministry of Agriculture and Food, Legislative Buildings, Toronto, Ontario, M7A 1B7.

TABLE 18. PESTICIDES USED TO PROTECT FRUIT CROPS

a — acaricide, miticide
b — bactericide
i — insecticide
f — fungicide
n — nematicide
h — herbicide
r — rodenticide

Common, Brand and Trade Names	Examples of Brand Name Product Common or other name of active ingredient	
Afalon	h	linuron
Agri-Mycin	b	streptomycin sulfate
Agristrep	b	streptomycin sulfate
Ambush	i	permethrin
amino triazole	h	Amitrol, amitrole
Amitrol	h	amino triazole
amino triazole + ammonium thiocyanate	h	Amitrol T, Cytrol
Amitrol + simazine	h	Amizine
Ammate X	h	ammonium sulfamate
anilazine	f	Dyrene
APM 50	i	azinphos-methyl
azinphos-methyl	i	Guthion, APM 50
Basfapon	h	dalapon
Basudin	i	diazinon
Belmark	i	fenvalerate
Benlate	f	benomyl
borax	f	sodium tetraborate deca-hydrate
bordeaux	f	prepared in spray tank from copper sulfate, hydrated lime and water
Botran	f	dichloran
captan	i	Orthocide
carbaryl	i	Sevin
captafol	f	Difolatan
Casoron	h	dichlobenil
Carzol	a	formetanate hydrochloride
chinomethionat	af	Morestan
chlorophacione		Rozol
chlordane	i	chlordane
chloropicrin	if	Telone C-17, Volex CP
chloroxuron	h	Tenoran
chlorthal dimethyl	h	Dacthal, DCPA
copper sulfate	bf	bluestone
cycloheximide	f	Actidione, Actispray
Cygon 4.8-E	ai	dimethoate
Cyhexatin	a	Plictran
Cytrol	h	amino triazole + ammonium thiocyanate
Cyprex	f	dodine
Dacthal	h	DCPA, chlorthal dimethyl
dalapon	h	Dowpon, Basfapon
dazomet	ifnh	Soil Kare (Mylone)
DCPA	h	Dacthal
D-D	h	1,2-dichloropropane, 1,3-dichloropropane mixture
Decis	i	deltramethrin
demeton	ai	Systox
diazinon	i	Basudin, Diazinon
dichlobenil	h	Casoron
2,4-D	h	2,4-dichlorophenoxyacetic acid
1,2-dichloropropane, 1,3-dichloropropene, mixture	n	D-D.
1-3-dichloropropene	n	Telone II, Telone C-17
dichlone	f	Phygon
dichloran		Botran
dicofol		Kelthane
Difolatan		captafool
Dikar	af	no common name
dimethoate		Cygon 480 E
Dinitro Dry	if	DNOc
dinocap	af	Karathane WD
dinoseb	ih	amine dinitro
diphenamid	h	Enide
disulfoton	ai	Di-Syston
Di-Syston	ai	disulfoton
Dithane M-22	f	maneb
Dithane M-45	f	mancozeb
Dithane ZL78	f	zineb
diphacinone	r	Ramik Brown
diuron	h	Karmex
DNOC	fi	Elgetol
Dowfume MC-2	ifnh	methyl bramide
Dawpon	h	dalapon
Dyfonate	i	fonofos
Dyrene	f	anilazine
Easout	t	thiophanate-methyl
endosulfan	i	Thiodan
Enide	h	diphenamid
fenvalerate	i	Belmark
fenbutatin	a	Torque
ferbam	f	Formate
fixed copper	b	Various formulations
folpet	f	Phaltan,
formetanate	a	Carzol
formaldelhyde	f	Formalin
Funginex	f	triforine
glyphosate	h	Roundup
Gramoxone	h	paraquat
Guthion	i	azinphos-methyl
hydrated lime (spray lime)		Various companies
Imidan	i	phosmet
irpodione	f	Rovral
Karathane WD	ia	dinocap
Karmex	h	diuron
Kelthane	a	dicofol
Kerb	h	propyzamid
Lannate	i	methomyl
Linuron	h	Lorox, Afalon
Lorox	h	linuron
malathion	ai	Malathion, various formulations

TABLE 18. PESTICIDES USED TO PROTECT FRUIT CROPS (Continued)

a – acaricide, miticide
b – bactericide
i – insecticide
f – fungicide
n – nematicide
h – herbicide
r – rodenticide

Common, Brand and Trade Names		Examples of Brand Name Product Common or other name of active ingredient
mancozeb	f	Dithane M45, Manzate200
maneb	f	Dithane M22, Manzate D, Mantox
Mantox	f	maneb
Manzate D	f	maneb
Manzate 200	f	mancozeb
MCPB	h	Tropotox
MCPB + MCPA	h	Tropotox Plus
MCPA-sodium salt	h	MCPA-sodium 300
metaldehyde		metaldehyde
metam-sodium	bifnh	Vapam, VPM
methidathion	i	Supracide
methoxychlor	i	Marlate
methyl bromide	ai	oxydemeton-methyl
mevinphos	ai	Phosdrin
Methyl isothiocyanate	bfnh	Vorlex
Morestan	af	oxythioquinox
Mylone	h	dazomet
Oxamyl	in	Vydate
Orthocide	f	captan
oxydemetonmethyl	ai	Meta-Systox-R
oil	ai	oil
Omite	a	propargite
parathion	ai	Various formulations
paraquat	h	Gramoxone
Parzate C	f	zineb
Parzate Liquid	f	nabam
permethrin	i	Ambush
Phaltan	f	folpet
phosalone	i	Zolone
Phosdrin	ai	mevinphos
Phygon	f	dichlone
Picfume	if	chloropicrin
Piperonyl butoxide	i	piperonyl butoxide
Pirimor	i	pirimicarp
Plictran	a	cyhexatin
Polyram	f	metiram
Ramik Brown	r	diphacinone
Princep	h	simazine
propargite	a	Omite
rotenone	i	rotenone
Roundup	h	glyphosate
Rovral	f	iprodion
Sevin	i	carbaryl
Sinox	ih	dinoseb
simazine	h	Princep, Simadex, Princep Nine T
Sinbar	h	terbacil
Soil Kare(Mylone)	ifnh	dazomet
streptomycin sulfate	b	Agristrep, Agri Mycin 17
sulfur	f	Various formulations
Supracide	i	methidathion
Systox	ai	demeton
Telone II	n	1,3-dichloropropene
Tenoran	h	chloroxuron
terbacil	h	Sinbar
Terraclor	f	quintozene (PCNB)
Terraklene	h	paraquat + simazine
Thiodan	i	endosulfan
thiram	f	Arasan
thiram rabbit repellent	f	Various formulations
Torque	a	tenbutatin oxide
triforine	f	Funginex
Tropotox	h	MCPB
Tropotox Plus	h	MCPB + MCPA
Vapam	bifnh	metam-sodium
Vorlex	bifnh	1,2-dichloropropane, 1,3-dichloropropene, methyl isothiocyanate mixture
VPM	bifh	metam-sodium
Vydate	i,n	oxamyl
zineb	f	Dithane Z-78
zinc phosphide orchard mouse bait		Various companies
ziram	f	Zerlate
Zolone	i	phosalone

OTHER PUBLICATIONS FOR THE COMMERCIAL FRUIT PRODUCER

The following publications, dealing with fruit production in Ontario, are available at your local office:

Ontario Ministry of Agriculture and Food

Publications

75	Guide to Chemical Weed Control
373	Orchard Sprayers
505	Ontario Weeds—For sale only, $2.50
431	Harvesting, Storing and Packing Apples

Factsheets

200/691	Air Pollution and Horticultural crops
200/842	Facts About the Ontario Food Terminal
202/51	Pick-Your-Own Harvesting
202/65	Storage Incompatibility
206/26	Compatibility and Pollination of Fruit Varieties
206/532	Leaf Analysis for Fruit Crops
206/564	Trickle Irrigation for Fruit Crops
210	Winter Injury in Fruit Trees
210/07	Critical Temperatures for Fruit Blossoms
210/11	Predicting Blossom Time in the Niagara Peninsula
210/24	Fruit Tree Pruning Time
210/24	Orchard Grafting Methods
210/24	Repair Grafting
210/24	Rules for Pruning Fruit Trees
210/24	Thinning Tree Fruits
210/63	Temporary Spring Storage of Young Fruit Trees
210/628	Root-Lesion Nematode in Ontario Orchards
210/681	Rodent Control in Orchards
210/744	Application Technique with Air-Blast Sprayers
211/10	Growing Delicious Apples in Ontario
211/36	Apple Rootstocks
211/65	Oxygen Pulldown Time in CA Storage
211/75	Frozen Apples
211/634	Fire Blight of Apple and Pear
211/634	Pin-Point Scab of Apples
211/690	Bitter-Pit Control in Apples
212/33	Peach Variety Identification
212/634	Bacterial Spot of Peach
212/634	Peach Canker in Ontario
212/634	Peach Leaf Curl
212/634	X-Disease of Peach
213/634	Bacterial Canker of Sweet Cherry
214/11	Growing Apricots
231/24	Bunch-Thinning and Suckering Grapes
231/24	Geneva Double Curtain System
231/624	Grape Berry Moth in Ontario
237/33	Red Raspberry Cultivars
238/10	Elderberries
606	Soil Fumigants
607	Farm Storage of Pesticides
607	Pesticide Contamination of Farm Water Supplies

Agriculture Canada Publications

1170	Growing Strawberries in Eastern Canada (varieties)
1171	Growing Strawberries in Eastern Canada (soil management)
1172	Growing Strawberries in Eastern Canada (planting and harvesting)
1196	Growing Red Raspberries in Eastern Canada
1289	Fruit Tree Propagation
1375	Orchard Replant Problems
1429	Pruning Apple Trees in Eastern Canada
1505	The Pruning Manual
1513	Pruning and Training Fruit Trees

METRIC EQUIVALENTS

LENGTH

inch = 2.54 cm - 25.4 mm
foot = 0.30 m
yard = 0.91 m
mile = 1.61 km

AREA

square foot = 0.09 m^2
square yard = 0.84 m^2
acre = 0.40 ha

VOLUME (dry)

cubic yard = 0.76 m^3
bushel = 36.37 L

VOLUME (liquid)

fluid ounce (Imp.) = 28.41 mL
pint (Imp.) = 0.57 L
gallon (Imp.) = 4.55 L
gallon (U.S.) = 3.79 L

WEIGHT

ounce = 28.35 g
pound = 453.6 g
ton = 0.91 tonne

PRESSURE

pounds per square inch = 6.90 kPa

THE METRIC SYSTEM

Linear Measures (length)

10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1000 metres = 1 kilometre (km)

Square Measures (area)

100 m x 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)

Cubic Measures (volume)

Dry Measure

1000 cubic millimetres (mm^3) = 1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)

Liquid Measure

1000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight — Volume Equivalents

(1.00 kg) 1000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)

Weight Measures

1000 milligrams (mg) = 1 gram (g)
1000 g = 1 kilogram (kg)
1000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Dry — Liquid Equivalents

1 cm^3 = 1 mL
1 m^3 = 1000 L

CONVERSION TABLES—METRIC TO IMPERIAL
(approximate)

Length

1 millimetre (mm) = 0.04 inch
1 centimetre (cm) = 0.40 inch
1 metre (m) = 39.40 inches
1 metre (m) = 3.28 feet
1 metre (m) = 1.09 yards
1 kilometre = 0.62 mile

Volume (liquid)

1 millilitre (mL) = 0.035 fluid ounce
1 litre (L) = 1.76 pints
1 litre (L) = 0.88 quart
1 litre (L) = 0.22 gallon (Imperial)
1 litre (L) = 0.26 gallon (U.S.)

Weight

1 gram (g) = 0.035 ounce
1 kilogram (kg) = 2.21 pounds
1 tonne (t) = 1.10 short tons
1 tonne (t) = 2205 pounds

Pressure
1 kilopascal (kPa) = 0.15 pounds/square inch

Area

1 square centimetre (cm^2) = 0.16 square inch
1 square metre (m^2) = 10.77 square feet
1 square metre (m^2) = 1.20 square yards
1 square kilometre (km^2) = 0.39 square mile
1 hectare (ha) = 107,636 square feet
1 hectare (ha) = 2.5 acres

Volume (dry)

1 cubic centimetre (cm^3) = 0.061 cubic inch
1 cubic metre (m^3) = 1.31 cubic yards
1 cubic metre (m^3) = 35.31 cubic feet
1000 cubic metres (m^3) = 0.81 acre-foot
hectolitre (hL) = 2.8 bushels

Speed

1 metre per second = 3.28 feet per second
1 metre per second = 2.24 miles per hour
1 kilometre per hour = 0.62 mile per hour

Temperature
°F = (°C x 9/5) + 32
°C = (°F -32) x 5/9

Proportion

1 litre per hectare = 14.24 fluid ounces per acre
1 kilogram per hectare = 14.50 ounces avdp per acre
1 kilogram per square centimetre = 14.23 pounds per square inch
1 hectolitre per hectare = 1.10 bushels per acre

Application Rate Conversions (Metric to Imperial—Approximate)

litres per hectare x 0.09 = gallons per acre
litres per hectare x 0.36 = quarts per acre
litres per hectare x 0.71 = pints per acre
millilitres per hectare x 0.015 = fluid ounces per acre
grams per hectare x 0.015 = ounces per acre
kilograms per hectare x 0.89 = pounds per acre
tonnes per hectare x 0.45 = tons per acre

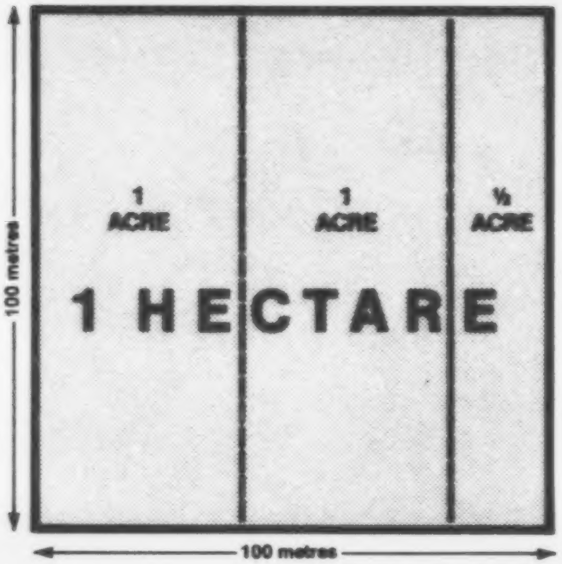
Dry Weight Equivalent

Grams, Kilograms/Hectare		Approximate Ounces, Pounds/Acre
100 grams	=	1-½ ounces
200 grams	=	3 ounces
300 grams	=	4-¼ ounces
500 grams	=	7 ounces
700 grams	=	10 ounces
1.10 kilograms	=	1 pound
1.50 kilograms	=	1-¼ pounds
2.00 kilograms	=	1-¾ pounds
2.50 kilograms	=	2-¼ pounds
3.25 kilograms	=	3 pounds
4.00 kilograms	=	3-½ pounds
5.00 kilograms	=	4-½ pounds
6.00 kilograms	=	5-¼ pounds
7.50 kilograms	=	6-¾ pounds
9.00 kilograms	=	8 pounds
11.00 kilograms	=	10 pounds
13.00 kilograms	=	11-½ pounds
15.00 kilograms	=	13-½ pounds

Liquid Equivalent

Litres/Hectare		Approximate Gallons/Acre
50	=	5
100	=	10
150	=	15
200	=	20
250	=	25
300	=	30

ACRES BECOME HECTARES



$100 \text{ m} \times 100 \text{ m} = 10{,}000 \text{ m}^2 = 1$ hectare (ha)

HECTARES TO ACRES

1 hectare = 2.5 acres
2 hectares = 5.0 acres
3 hectares = 7.4 acres
4 hectares = 10.0 acres
5 hectares = 12.4 acres
6 hectares = 15.0 acres
7 hectares = 17.3 acres
8 hectares = 20.0 acres
9 hectares = 22.2 acres
10 hectares = 25.0 acres
20 hectares = 50.0 acres
30 hectares = 74.0 acres
40 hectares = 100.0 acres
50 hectares = 123.5 acres

ACRES TO HECTARES

1 acre = 0.4 hectares
2 acres = 0.8 hectares
3 acres = 1.2 hectares
4 acres = 1.6 hectares
5 acres = 2.0 hectares
6 acres = 2.4 hectares
7 acres = 2.8 hectares
8 acres = 3.2 hectares
9 acres = 3.6 hectares
10 acres = 4.0 hectares
20 acres = 8.0 hectares
30 acres = 12.0 hectares
40 acres = 16.0 hectares
50 acres = 20.0 hectares
60 acres = 24.0 hectares
70 acres = 28.0 hectares
80 acres = 32.0 hectares
90 acres = 36.0 hectares
100 acres = 40.0 hectares

METRIC APPLICATION RATES WITH AN ACRE PERSPECTIVE

Dry Weight

10 g/ha = 4 g/acre
20 g/ha = 8 g/acre
30 g/ha = 12 g/acre
40 g/ha = 16 g/acre
50 g/ha = 20 g/acre
100 g/ha = 40 g/acre
500 g/ha = 200 g/acre
1000 g/ha = 400 g/acre
1 kg/ha = 400 g/acre (0.4 kg/acre)
2 kg/ha = 800 g/acre (0.8 kg/acre)
3 kg/ha = 1.2 kg/acre
4 kg/ha = 1.6 kg/acre
5 kg/ha = 2 kg/acre
10 kg/ha = 4 kg/acre
20 kg/ha = 8 kg/acre
30 kg/ha = 12 kg/acre
40 kg/ha = 16 kg/acre
50 kg/ha = 20 kg/acre
100 kg/ha = 40 kg/acre
500 kg/ha = 200 kg/acre
1000 kg/ha = 400 kg/acre
1 tonne/ha = 400 kg/acre

Liquid Volume

10 mL/ha = 4 mL/acre
20 mL/ha = 8 mL/acre
30 mL/ha = 12 mL/acre
40 mL/ha = 16 mL/acre
50 mL/ha = 20 mL/acre
100 mL/ha = 40 mL/acre
500 mL/ha = 200 mL/acre
1000 mL/ha = 400 mL/acre
1 L/ha = 400 mL/acre (0.4 L/acre)
2 L/ha = 800 mL/acre (0.8 L/acre)
3 L/ha = 1.2 L/acre
4 L/ha = 1.6 L/acre
5 L/ha = 2 L/acre
10 L/ha = 4 L/acre
20 L/ha = 8 L/acre
30 L/ha = 12 L/acre
40 L/ha = 16 L/acre
50 L/ha = 20 L/acre
100 L/ha = 40 L/acre
500 L/ha = 200 L/acre
1000 L/ha = 400 L/acre

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